Aviation Week
and Space Technology

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A McGraw-Hill Publication

April 24, 1961

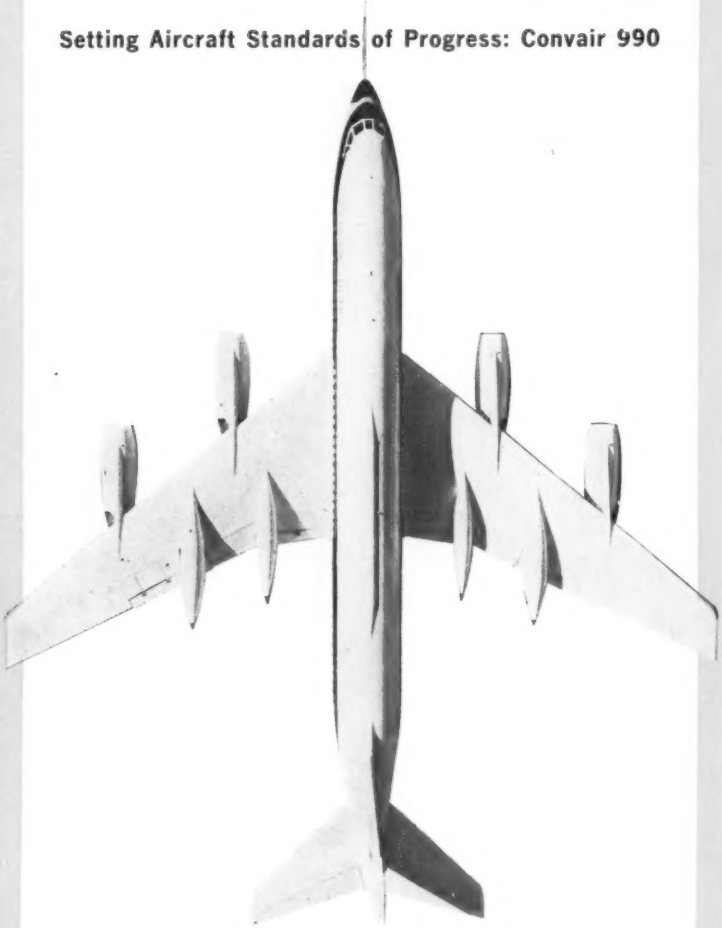
Pilot Report:

Twin Beech Tricycle Gear Conversion

Sud Frelon Prototypes

U.S. Companies Reappraise Foreign Licensing

Setting Aircraft Standards of Progress: Convair 990



WORLD'S FASTEST JET AIRLINER, the Convair 990, will streak through the skies at near-sonic cruising speeds of 635 miles an hour in non-stop intercontinental and medium-range flights. Helping this big, new sister ship of the Convair 880 achieve its tremendous thrust are four "speed capsules," or aerodynamic anti-shock bodies on the swept-back wings. Kaylock® lightweight, all-metal self-locking nuts are used extensively throughout the airframe of this great new luxury airliner.

Setting Locknut Standards of Progress: Kaylock® HW 14

This new, pre-assembled washer-locknut unit has gained wide industry acceptance since its introduction by Kaynar. Integral free-spinning washer can't drop off during application or removal. Danger of short circuits due to forgotten washer has been eliminated. Write today for your free Kaylock Captive Washer Nut Brochure.

HW-14 CAPTIVE WASHER NUT

Kaylock® first in lightweight locknuts

Kaylock® Offers You the World's Largest Selection of Lightweight Self-Locking Nuts

MK 7200 Miniature Stake Nut

MF 7200 Miniature Floating Stake Nut

K 8000 High-Strength Thin-Wall Insert

H 14 6-Point Reduced Height Nut, 160,000 PSI rating

HW 14 6-Point Captive Washer Nut, 160,000 PSI rating

H 10 Hex Nut

G 1000 Narrow C'Bored Gang Channel, 250°F

K 1000 Two-Lug Anchor Nut

K 2000 One-Lug Anchor Nut

K 3000 Corner Anchor Nut

F 5000 Two-Lug Floating Anchor Nut

F 2000 One-Lug Floating Anchor Nut

MK 1000 Two-Lug Miniature Anchor Nut

MK 2000 One-Lug Miniature Anchor Nut

MK 3000 Corner Miniature Anchor Nut

MK 4000 Short-Lug Miniature Anchor Nut

MF 1000 Two-Lug Miniature Floating Anchor Nut

MF 6000 Right Angle Basket Miniature Floating Anchor Nut

F 1968 Two-Lug Self-Sealing Dome Anchor Nut

H 25 12-Point High Fatigue Nut, 220,000 PSI rating

H 35 12-Point High Fatigue Nut, Reduced Wrench, 1200°F

For additional information on the complete Kaylock line, call your Kaynar sales representative today.

KAYNAR MFG. CO., INC.—KAYLOCK DIVISION
Box 2001 Terminal Annex, Los Angeles 54, Calif.
Branch offices, warehouses & representatives in Wichita, Kansas; New York, N.Y.; Atlanta, Ga.; Renton, Wash.; Montreal; Paris; London; The Hague

GOODYEAR

RADAR STRUCTURES: Another prime capability of Goodyear Aircraft

To "see" and stop missiles in space is Nike-Zeus mission. Since ICBM time-to-target is about 30 minutes, system has only few minutes to detect enemy missile, compute course, launch and guide Nike-Zeus missile to intercept point.

A NEW "EYE" FOR SIGHTING HOSTILE ICBM's

Only active defense against hostile ICBM's under development today is Army's Nike-Zeus anti-missile system. Nike-Zeus combines one of the most sensitive multiple-target radars yet perfected with the Free World's fastest interceptor missile. Object: detection and destruction of ICBM's flashing through space at close to 20,000 m.p.h.

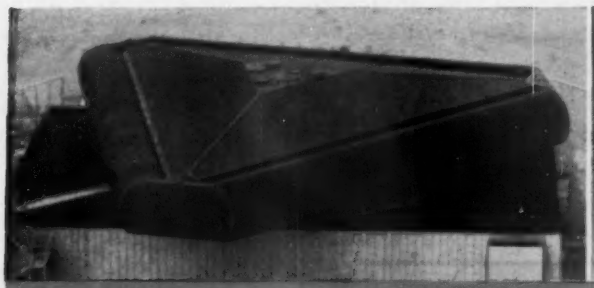
As a leading producer of radar structures of all types, Goodyear Aircraft was selected to work with Bell Telephone Laboratories to develop, design and build the large acquisition radar transmitting and receiving antennas shown here. Working with Western Electric the prime contractor, and a team of major Nike-Zeus subcontractors, Goodyear has already furnished operating prototypes of the antennas. And, currently, work is well under way on manufacturing techniques for volume production. For details on Goodyear's extensive experience in advanced radar structures write Goodyear Aircraft Corporation, Dept. 914AD, Akron 15, Ohio.

GOODYEAR

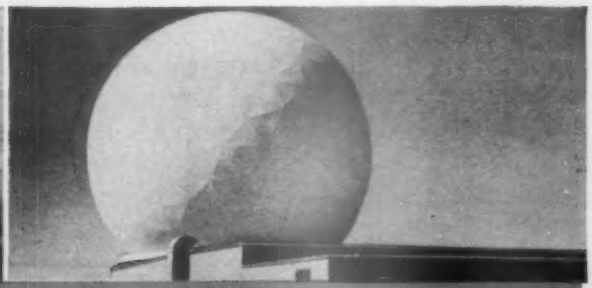
GOODYEAR AIRCRAFT CORPORATION

Plants in Litchfield Park, Arizona, and Akron, Ohio

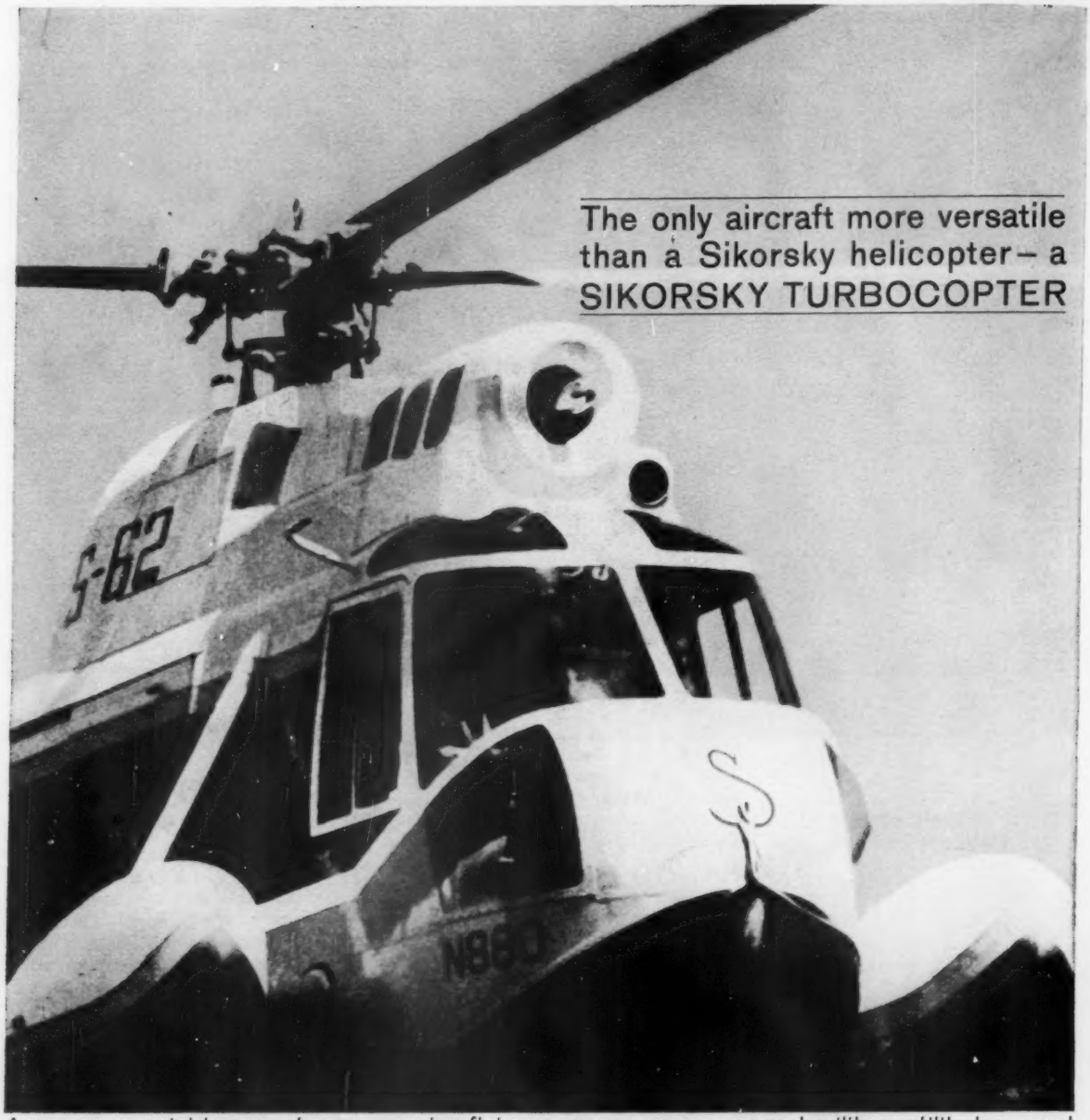
The Technical Disciplines involved in these areas offer a challenging future for Engineers and Scientists at Goodyear Aircraft. Write today.



Goodyear-built transmitting antenna consists of three 80-ft. apertures in triangular lineup rotating continuously in azimuth while accurately slaved to the receiving antenna.



World's largest Luneberg lens for focusing radar echoes is housed in this 110-ft. radome. Radome contains 445 triangular plastic panels attached to a space-frame.



The only aircraft more versatile than a Sikorsky helicopter – a SIKORSKY TURBOCOPTER

As a commercial transport, cargo carrier, flying crane, company car and military utility transport—job for job—the new Sikorsky turbocopters exceed in versatility any copter ever built. They are powered by the world's first turbine engine developed specifically for helicopters and are equipped with a true flying boat hull. □ America's first turbocopter to be certified by the FAA for commercial operations, the Sikorsky S-62 carries nine passengers in its airline-type cabin. It operates with turbine engine reliability, low noise level and lack of vibration—from land, water, snow, marsh, tundra, almost any surface. In operations on the West Coast, the S-62 has proved faster in and out of heliports, has shown higher cruise speed and increased payload with up to 30% savings in fuel cost over piston-powered helicopters. □ Can Sikorsky turbocopters serve and save in your flying operations? To get the answer, tell us on your letterhead something about your transport needs.

UNITED AIRCRAFT CORPORATION
SIKORSKY AIRCRAFT DIVISION
STRATFORD, CONNECTICUT

AVIATION CALENDAR

May 2-4—Electronic Components Conference, Institute of Radio Engineers, Jack Tarr Hotel, San Francisco, Calif.

May 3-5—17th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 3-5—Nuclear Applications in Space Conference, American Rocket Society/Oak Ridge National Laboratory, Gatlinburg, Tenn.

May 4-5—Second National Symposium, Human Factors in Electronics, Institute of Radio Engineers, Marriott-Twin Bridges Motor Hotel, Arlington, Va.

May 6-9—Fifth Midwest Symposium on Circuit Theory, Institute of Radio Engineers, University of Illinois, Urbana.

May 8-10—Spring Lubrication Symposium, American Society of Mechanical Engineers, Deauville Hotel, Miami Beach.

May 8-10—National Aerospace Electronics Conference, IRE, Miami and Biltmore Hotels, Dayton, Ohio.

May 8-12—Annual Meeting, Airport Operators Council, Carillon Hotel, Miami Beach, Fla. (AOC-American Society of Civil Engineers' Joint Seminar, "Increased Capacity of Airport Systems," May 11-12.)

May 9-11—Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

May 10-12—Spring Meeting, Society for Experimental Stress Analysis, Benjamin Franklin Hotel, Philadelphia, Pa.

May 11—Air Force Office of Scientific Research Lecture and Banquet in honor of the 80th Anniversary of Theodore von Karman, Sheraton Park Hotel, Washing-

(Continued on page 6)

AVIATION WEEK and Space Technology

April 24, 1961
Vol. 74, No. 17

Published weekly with an additional issue in December by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y. Printed at Albany N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Joseph A. Gerardi, Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary.

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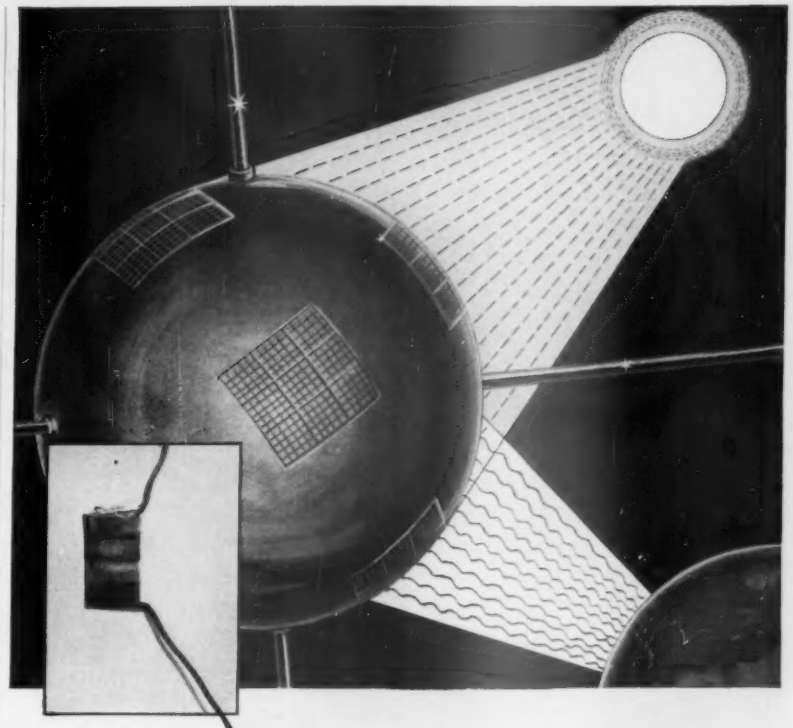

Taming the sun's energy to solar battery needs

Bausch & Lomb optical/electronic/mechanical capabilities increase cell efficiency

The only trouble with solar energy for satellite power supply is that there's too much of it. Only about 10% of the sun's radiation can be transformed into electrical energy. The remaining 90% just heats the solar cells, reducing their efficiency.

Bausch & Lomb coatings enhance the efficiency of solar cells by allowing them to operate at cooler temperatures. "Blue" (see typical curve) coatings—selectively absorb the radiation needed to energize the cells. The "Red-blue" coatings bounce the hot infra-red radiation back into space (see typical "red-blue" curve).

Find out how B&L capabilities can help out on *your* next project—in design, development and production. Ask for our technical reports: Bausch & Lomb Incorporated, Military Products Division 99416 Bausch Street, Rochester 2, N. Y.

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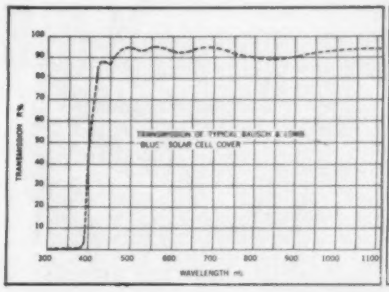
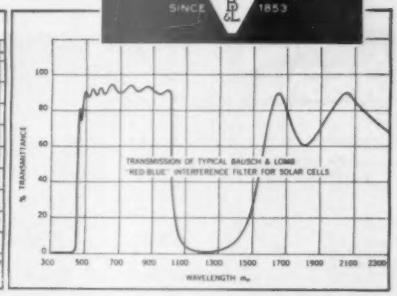
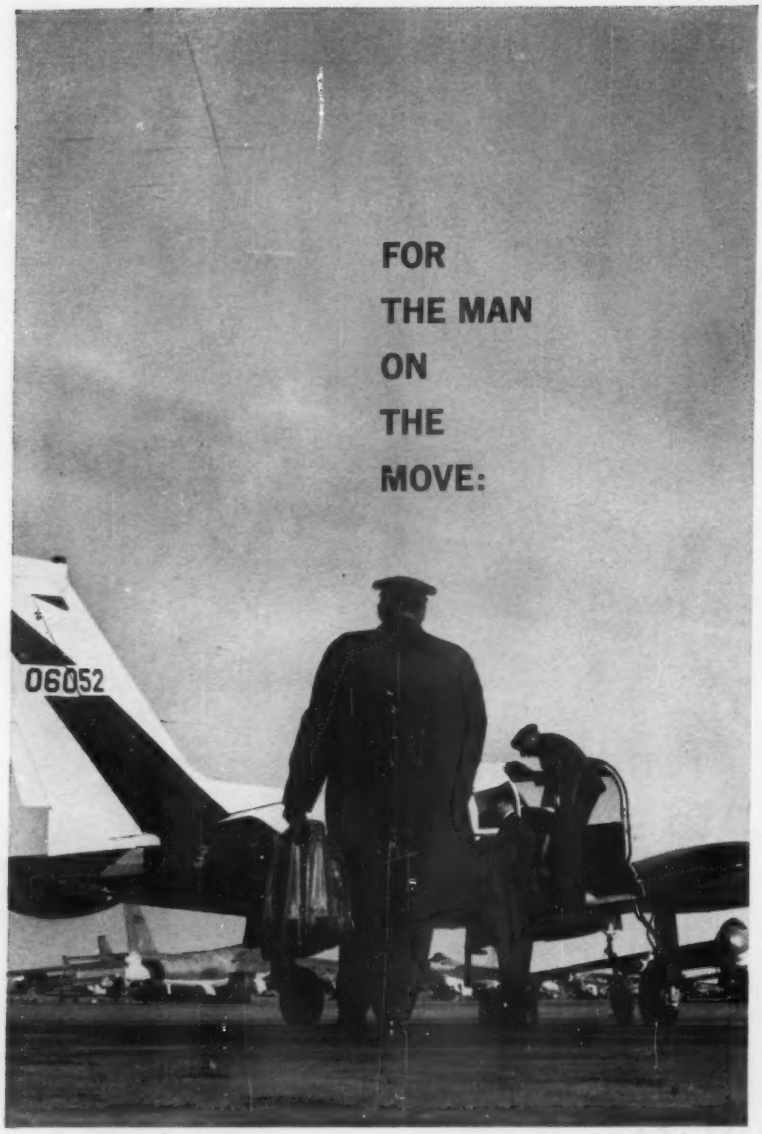
SINCE 1853







Cessna U-3B. Much of the U-3B's value to USAF's high-priority transportation requirements lies in its readiness to move out at minutes' notice. For itself, it requires minimum preparation; for its passengers, none at all. And because of a unique nationwide off-the-shelf support program—conceived and conducted by Cessna—it puts up with few mechanical delays: along with the lowest operating cost, it has the highest in-commission rate of any plane in the Air Force today.

World's most experienced makers of utility military aircraft

AVIATION CALENDAR

(Continued from page 5)

ton, D. C.

May 12—National Armed Forces Day Dinner, Sheraton Park Hotel, Washington.

May 12-14—Mid-America Air Fair, Municipal Airport, Wichita, Kan.

May 15-16—Region One Air Traffic Control Assn. Convention, Hotel Bradford, Boston, Mass.

May 15-16—Aviation Fire Safety Seminar and Technical Session, National Fire Protection Assn., Hilton Statler Hotel, Detroit, Mich.

May 15-17—National Symposium on Microwave Theory and Techniques, IRE, Sheraton Park Hotel, Washington, D. C.

May 15-18—20th Annual National Conference, Society of Aeronautical Weight Engineers, Sheraton Hotel, Akron, Ohio.

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 22-24—Fifth National Symposium on Global Communications, Institute of Radio Engineers, Hotel Sherman, Chicago.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

May 27-30—13th Annual Wright Memorial Glider Meet, Soaring Society of Dayton, Dayton, Ohio.

May 31-June 2—University of Michigan's Seventh Annual Radar Symposium, Ann Arbor, Mich.

June 2-3—12th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.

June 13-15—National Joint Meeting, Institute of the Aerospace Sciences and American Rocket Society, Ambassador Hotel, Los Angeles, Calif.

June 13-15—37th Meeting, Aviation Distributors and Manufacturers Assn., Dennis Hotel, Atlantic City, N. J.

June 14-15—Fifth Annual Conference, Product Engineering and Production, Institute of Radio Engineers, Sheraton Hotel, Philadelphia, Pa.

June 22-23—Eighth Annual Symposium on Computers and Data Processing, Denver Research Institute, Elkhorn Lodge, Estes Park, Colo.

June 26-28—Fifth National Convention on Military Electronics, Institute of Radio Engineers, Shoreham Hotel, Washington.

June 26-30—Special Technical Conference, American Institute of Electrical Engineers' Aerospace Transportation Committee, Benjamin Franklin Hotel, Philadelphia.

June 28-July 1—Annual Meeting, Institute of Navigation, Williamsburg Inn, Williamsburg, Va.

July 25-Aug. 10—International Trade Fair and Aviation Exhibition, McCormick Place Exposition Center, Chicago, Ill.

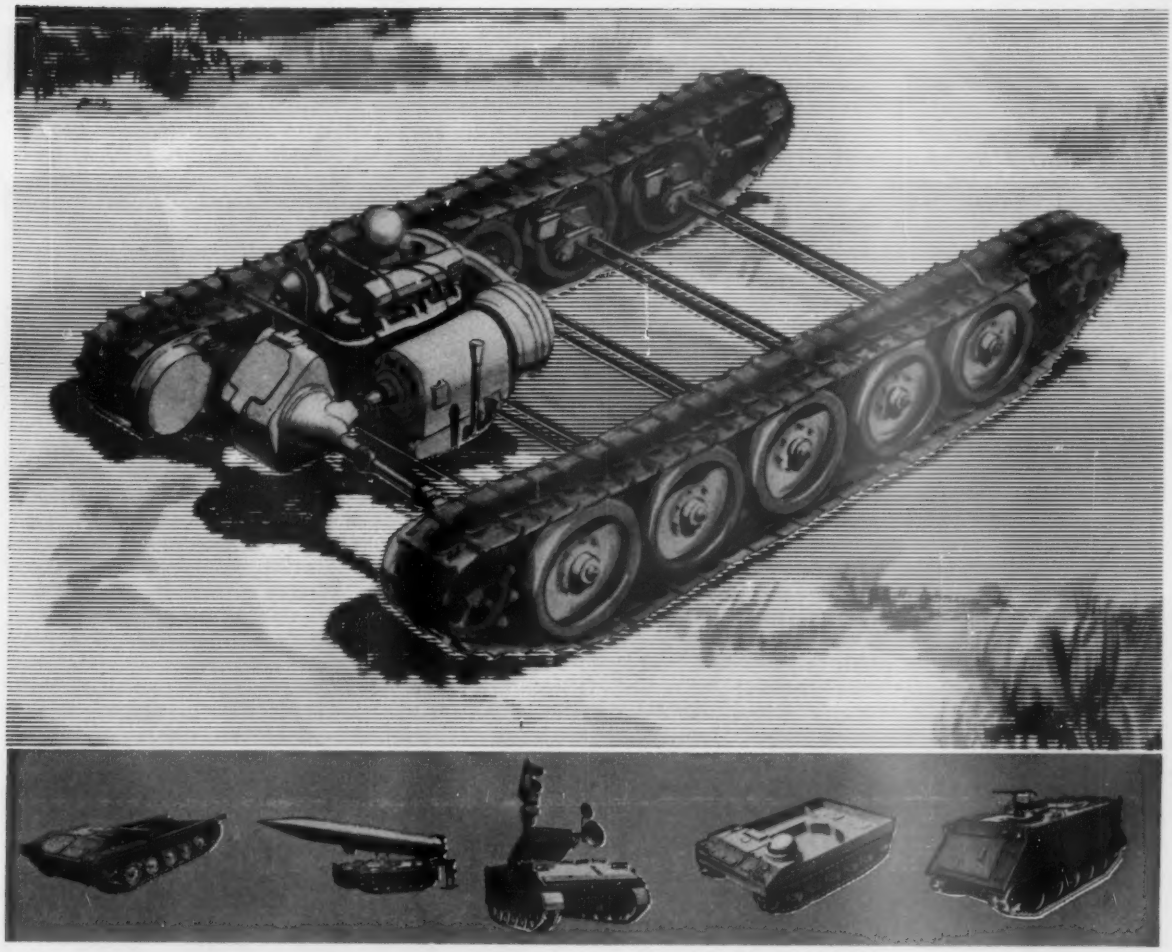
Aug. 22-25—Western Electronic Show and Convention, Cow Palace, San Francisco.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 6-8—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

Sept. 10-12—National Convention, National Aeronautic Assn., Westbury, N. Y.

Oct. 2-7—12th International Astronautical Congress, Washington, D. C.



STANDARDIZATION CUTS R & D COSTS AND REDUCES MILITARY LOGISTIC BURDEN

Food Machinery and Chemical Corporation, working closely with the Ordnance Tank Automotive Command and the using forces, has put the standardization idea to work.

A prime example is the modern Army's multipurpose vehicle family. Based on the M113, an entire family of vehicles ranging from armored personnel carriers to unarmored missile carriers has been developed that uses the same engine, power train and suspension as interchangeable components. This standardization saves research and development dollars, adds production economy, and eases logistic problems in field operation.

Take advantage of these cost saving factors in planning your mobile GSE equipment. Call in FMC engineers at the concept stage of your project.

For further information, write on company letterhead to Preliminary Design Engineering Dept., FMC Ordnance Division, P.O. Box 367, San Jose, Calif. Phone CYpress 4-8124.

Putting Ideas to Work

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FOOD MACHINERY AND CHEMICAL CORPORATION

Ordnance Division

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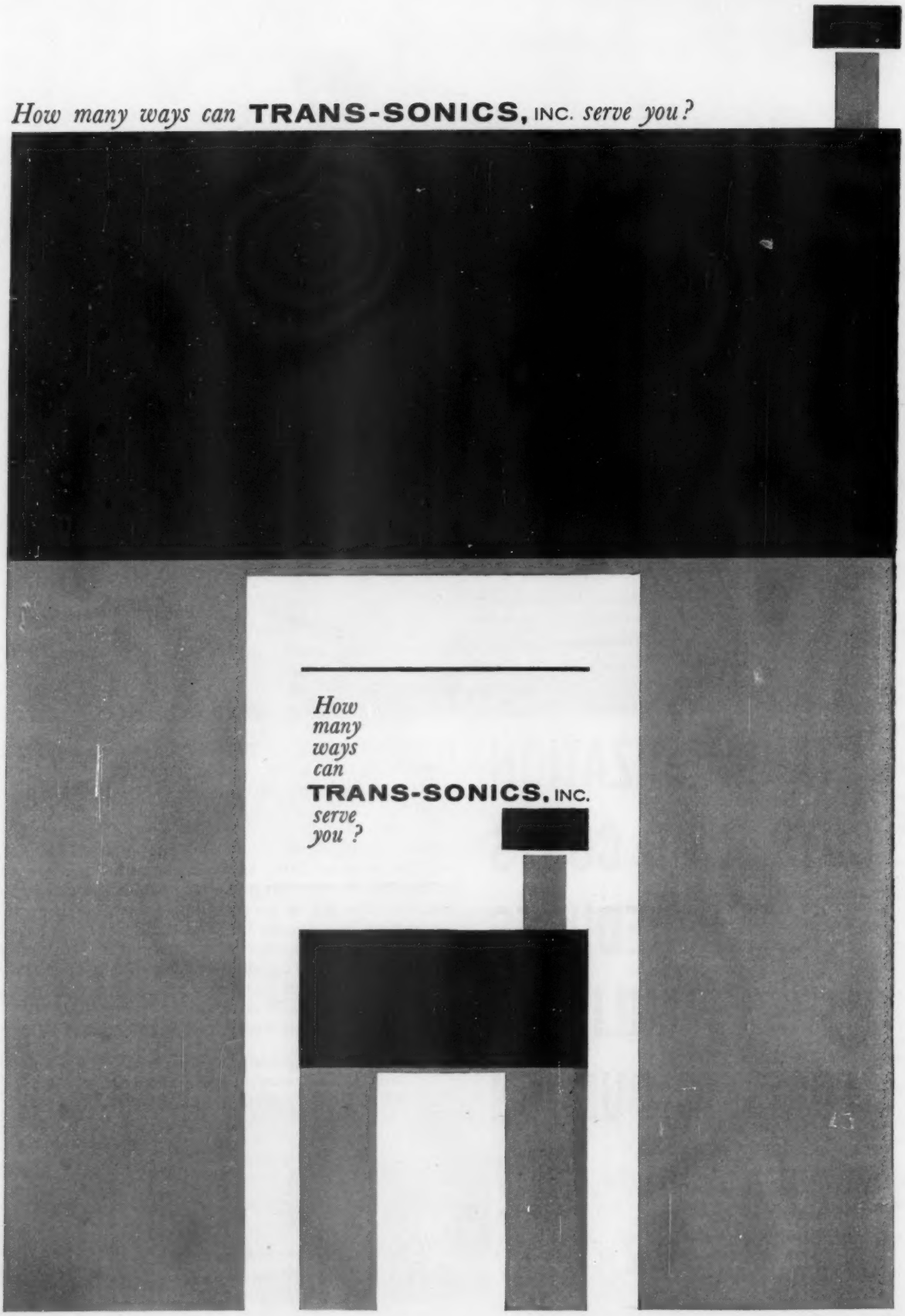

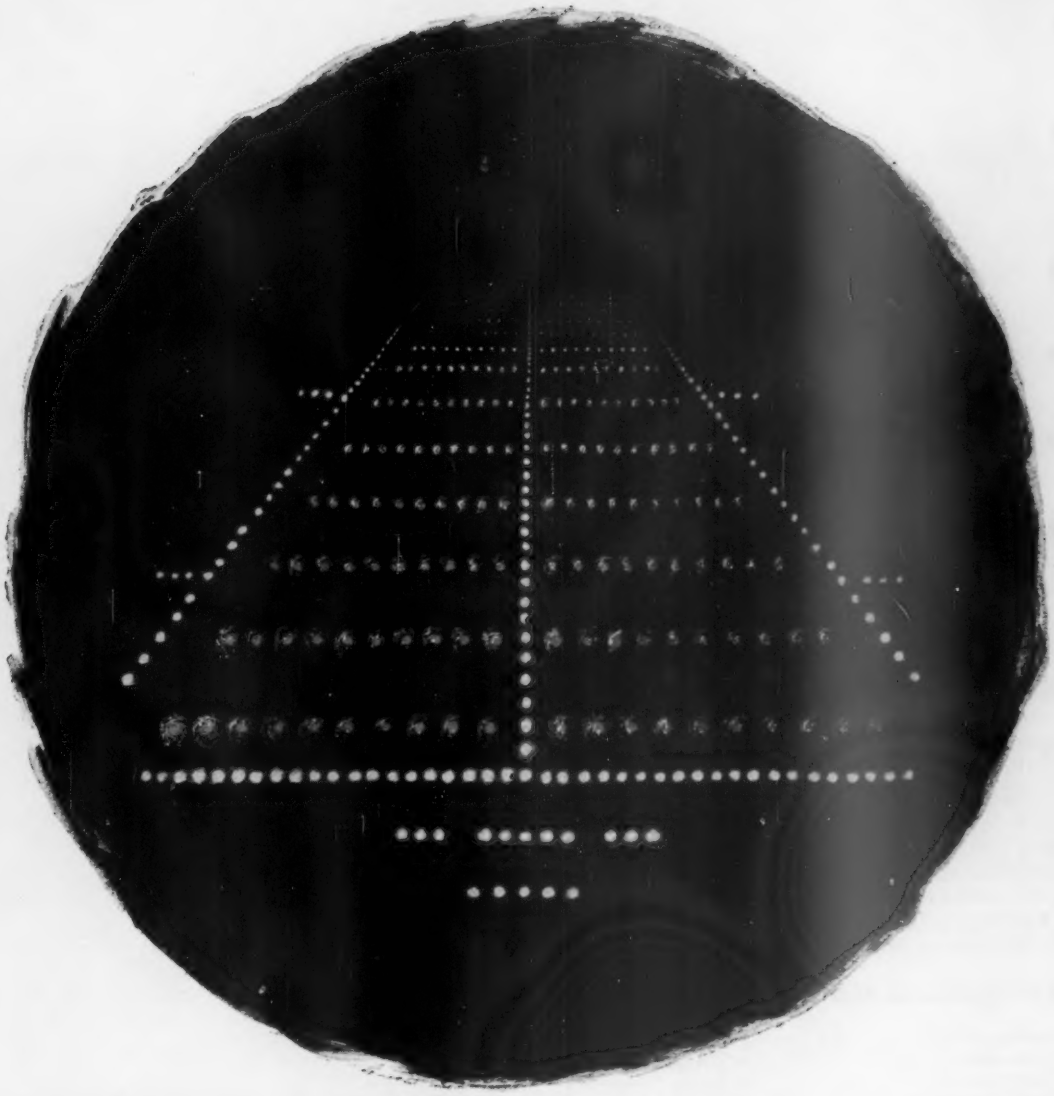

RUNWAY CLEAR...AT FORTY FATHOMS

Just as runway lights establish the boundaries of a landing strip at night . . . and the pilot relies on electronic eyes to see through clouds and darkness . . . submarines can be fully oriented to the dim depths of the sea by a continuous set of signals. Norden's contact analog display in the submarine's control room reveals on a single screen every key parameter: pitch, roll, heading, surface and bottom positions. This sophisticated system utilizing advanced television and computer techniques, was developed for the Navy's Bureau of Ships . . . from concept to hardware in less than 18 months. With minor modifications, the display is applicable to aircraft.

This is just one of several important programs at Norden involving advanced television, radar, digital computing, and digital control systems. The contact analog display, pointing out the runway beneath the sea, demonstrates Norden's primary mission, EXTENDING MAN'S CAPABILITIES.

NORDEN division of **UNITED AIRCRAFT CORPORATION**

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Forging our missile arsenal and spacecraft fleet

Trustworthy metal quality . . . exacting compliance with specifications . . . notable experience with exotic metals and alloys—these are reasons Wyman-Gordon is so often chosen to produce the difficult, the critical, even the predicted "unforgeable" in missile hardware. Specialized facilities, coupled with advanced metallurgical research, offer space-vehicle designers continually expanding frontiers in vital areas of size, complexity, materials and strength-to-weight ratios of forged airframe and propulsion components.

OPERATIONAL and PROTOTYPE HARDWARE PRODUCED

- Re-entry shields
- Domes and closures
- Support beams
- Cones and nozzles
- Pressure vessels
- Motor casings
- Bulkheads and rings
- Turbine components
- Fins and vanes
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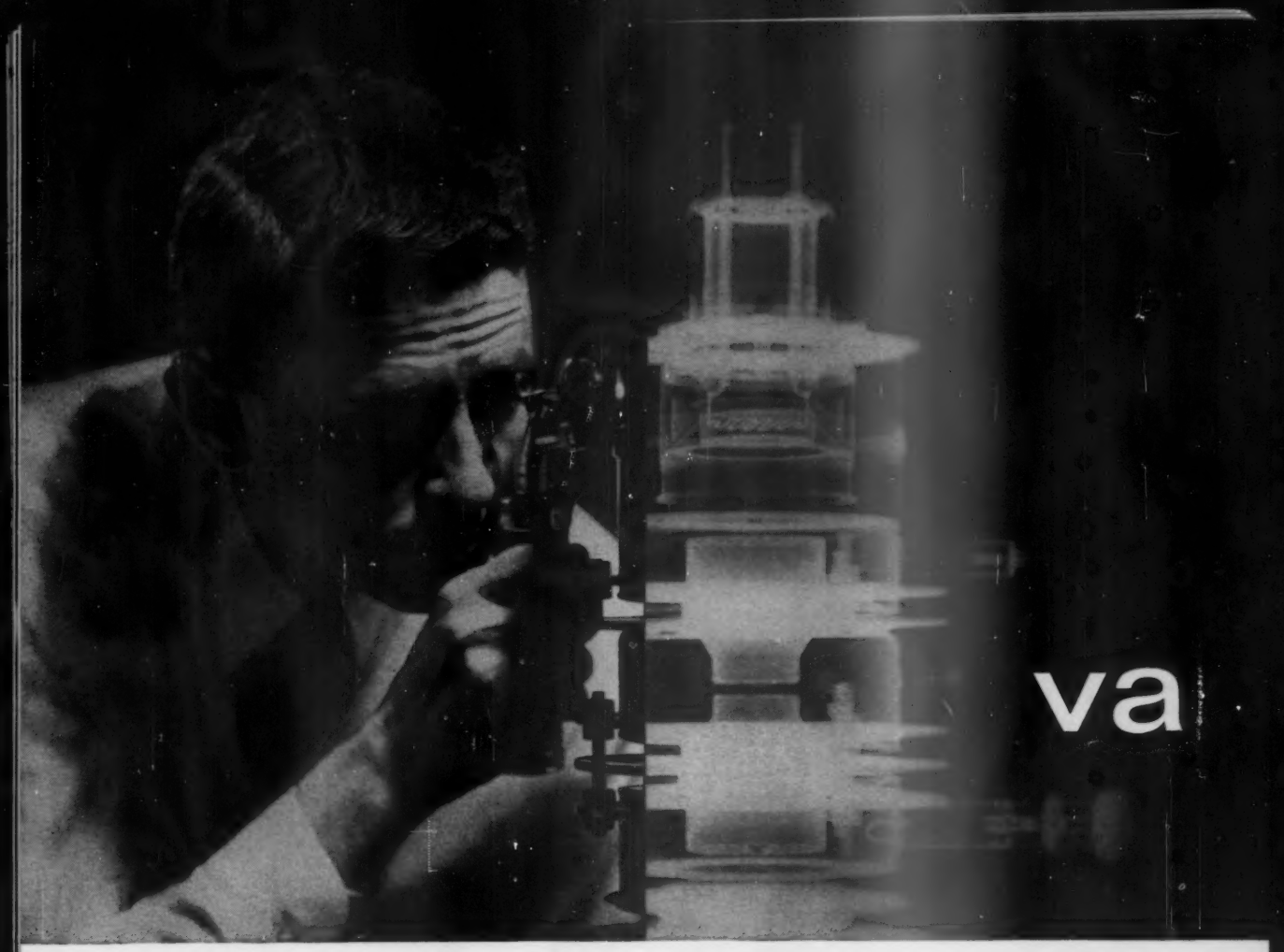
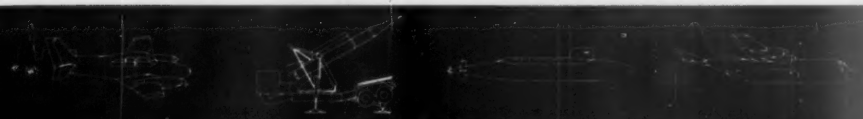


Value Analysis (VA) is an X-ray-like Sperry program designed to take a "second look" at products in the hardware stage. Every component part, material and production technique is challenged. The objective: lowest product cost at no sacrifice to essential quality and performance.

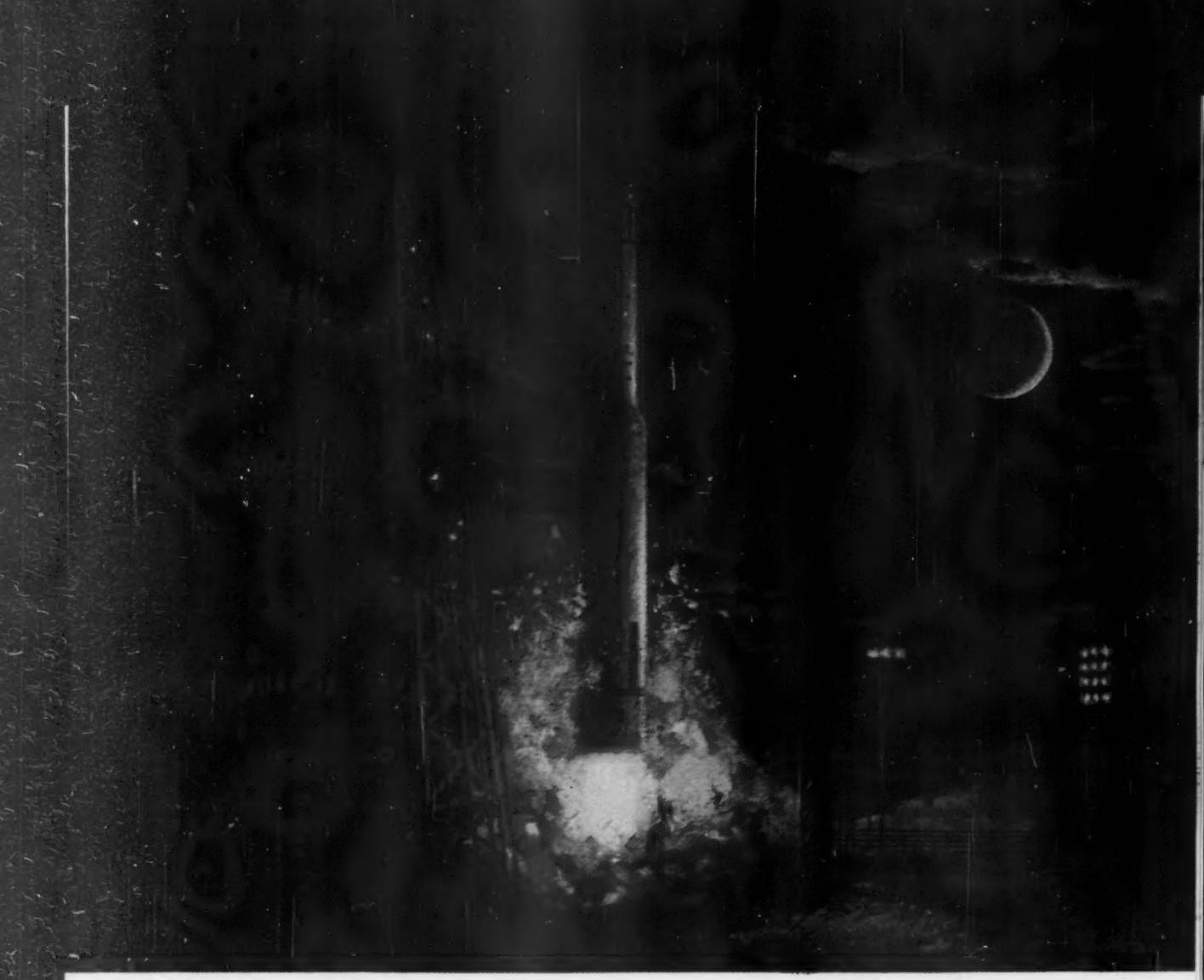
Sperry VA teams–specialists in engineering, product methods, purchasing and quality control–are attaining dramatic reductions in costs in a wide range of products and systems.

By introducing value analysis in the design stage as well, additional millions of dollars will be saved for the customer and the taxpayer. General offices: Great Neck, N. Y.



Some typical Sperry programs benefiting from Value Analysis: (left to right) SP-3 Automatic Pilot for light aircraft; Army's SERGEANT missile system; Navy's Mark 19 Gyro-Compass; USAF's APN-59 Airborne Radar System; Klystron tubes for long range radar systems (main illustration).

SPERRY



Kinetics motor-driven switches provide maximum reliability for missiles and aircraft

This 2-pole, double-throw switch, Model M-145-3, applies the Kinetics motor-driven switch design to achieve ultra reliability for missile and aircraft applications.

For any missile or aircraft application where absolute reliability is a *must*, specify Kinetics motor-driven switches. They are available in a complete line of sizes ranging from single-pole, single-throw to 100-pole, double-throw. The design is extremely compact and lightweight. Smaller models weigh just a few ounces. The 100-pole, double-throw model weighs only 5 lbs.

Kinetics switches are used in missiles for main power changeover, range safety systems, destruct circuits, telemetry applications, battery transfer and a multitude of other uses. Switches are now being supplied for three major intercontinental ballistic missile programs, one land-launched and one submarine launched intermediate range ballistic missile, two reconnaissance satellite programs and three space vehicles.

Kinetics switches are frequently specified as a replacement for relays to insure absolute reliability. There are no latching devices or similar relay elements of any kind to cause trouble. Switches may be transferred at 40 G's, 2000 cycles. Once they are transferred, no power is required to hold them in position, saving batteries.

The switches exhibit no contact chatter over the whole vibration spectrum, from 5 to 2000 cycles, 40 G's. Voltage drop across contacts is less than 10 millivolts at 15 amps. Switches are available with extremely fast transfer times of 35 milliseconds. For help with your switch requirements, write or phone Kinetics Corporation, Dept. KA-4, 410 S. Cedros Avenue, Solana Beach, Calif. SKyline 5-1181.

KINETICS CORPORATION

ELECTRONICS · ELECTROMECHANICS

FAA Approved—can be worn off the face up to 35,000 ft.

A new, light-weight, low cost oxygen mask, equipped with a unique suspension device, incorporating an over-center locking mechanism to provide instant, positive seal.

The ease and speed of donning is amazing. The mask, with one hand, is brought from the "ready" to the "donned" position in one fast motion. Put it on and forget it . . . until you need it! Use the Jet-Set suspension assembly with or without microphone installed. Adjusts to any face and head shape.

Write for complete information.

- **Comfortable to wear**
- **Does not interfere with sunglasses, headphones or hand mike**
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- **New Velcro head harness stays in place — no buckles to adjust**
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- **New silicone mask design provides a new standard of comfort**
- **Available in 4 sizes and shapes**
- **Silicone mask resists aging and ozone deterioration**

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From jet aircraft and missiles to automobiles and fractional horsepower motors, Purolator filters are part of advanced engineering design

Sixty-five Purolator filters perform vital functions on the Boeing 707, 720, Douglas DC-8, Convair 600 and Convair 880. Purolator filters form an integral part of such missile systems as the Hawk, Polaris, Jupiter, Atlas Terrier and Hound Dog.

In fact, we filter *all* fluids vital to the proper operation of aircraft, rockets, automobiles and other machines – be they air, fuels, lube oils, or hydraulic fluids. In each case, the Purolator filter is designed specifically for the job.

Do you have an engineering development in mind that would benefit by filtration? We're the world's largest, most-diversified maker of filters. Chances are, one of our more than 2,000 units will do the job. If not – we'll design and make a filter that will. Let us know your requirements.

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...key to life

Water means power . . . water means raw materials . . . water means the life of the maritime nations. Still—man is ignorant of the mysteries of the oceans . . . he is only beginning to search the depths.

General Motors Defense Systems Division is vitally interested in all ocean phenomena. For example, new nuclear submarines and their cargoes of ballistic missiles constitute one of America's most effective deterrents against attack. Water—and the *control* of water—is vital to national defense.

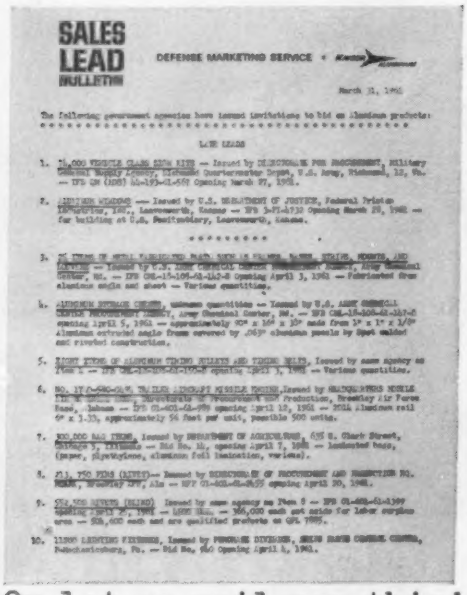
Scientists and engineers in the laboratories of the Defense Systems Division are also hard at work in land, aero-space, astrophysics, biological sciences, oceanography, nucleonics, and basic research projects.

DSD is dedicated to serving the Defense Department and other government agencies, in cooperation with many different branches of industry and scientific groups, in fields of fundamental research and engineering through the coordination of knowledge, abilities, ideas and hard work.

General Motors is proud to contribute, through the growing Defense Systems Division, to the strength of America and human progress. Top-level scientists and engineers in all of these specialized fields will find rare opportunities and challenging assignments in this fast-growing organization.

DEFENSE SYSTEMS DIVISION, GENERAL MOTORS CORPORATION, WARREN, MICHIGAN AND SANTA BARBARA, CALIFORNIA

You could wade thru all this...



SALES LEAD BULLETIN

DEFENSE MARKETING SERVICE • KAISER ALUMINUM

March 31, 1961

The following government agencies have issued invitations to bid on aluminum products:

LINE LEADS

1. 24,000 VEHICLE CLEAN SPOT KITS — Issued by HEADQUARTERS FOR PROCUREMENT, Military Clothing Supply Agency, Defense Quartermaster Depot, U.S. Army, Richmond, 12, Va. — IFB QM (2083) 61-193-61-55P Opening March 27, 1961.

2. ALUMINUM WINDOWS — Issued by U.S. DEPARTMENT OF JUSTICE, Federal Prison Industries, Inc., Leavenworth, Kansas — IFB 3-71-4732 Opening March 28, 1961 — for building at U.S. Penitentiary, Leavenworth, Kansas.

3. [illegible] — Issued by U.S. ARMY CHEMICAL [illegible], Army Chemical Center, Md. — IFB CML-15-109-61-1A2-B Opening April 3, 1961 — Fabricated from aluminum angle and sheet — Various quantities.

4. ALUMINUM EXTRUDED CHANNEL, minimum quantities — Issued by U.S. ARMY CHEMICAL [illegible], Army Chemical Center, Md., — IFB CML-15-109-61-1A3-C opening April 5, 1961 — approximately 60" x 10" x 10" made from 1" x 1" x 1/8" Aluminum extruded angle frame covered by .063" aluminum panels by Spot welded and riveted construction.

5. EIGHT KINDS OF ALUMINUM TRIMMING BULLETS AND TRIMMING BELTS. Issued by same agency as Item 4. — IFB CML-15-109-61-1A5-A opening April 5, 1961 — Various quantities.

6. NO. IV-C-SNC-61-T, TRAILER, MISSILE ENGINE, Issued by HEADQUARTERS MISSILE [illegible], Directorate of Procurement and Production, Strategic Air Force Base, Labrea — IFB 61-603-61-999 opening April 12, 1961 — 7075A aluminum roll 6" x 1-35, approximately 56 feet per unit, possible 500 units.

7. 300,000 BAG ITEMS, issued by DEPARTMENT OF AGRICULTURE, 635 S. Clark Street, Chicago 5, Illinois — Bid No. 31, opening April 7, 1961 — laminated bags, (paper, polyethylene, aluminum foil lamination, various).

8. 211,750 PINS (RIVET)— Issued by DIRECTORATE OF PROCUREMENT AND PRODUCTION NO. MAIN, Brooks AFB, San — IFB 61-601-61-8455 opening April 20, 1961.

9. 572,500 RIVETS (BLIND) Issued by same agency as Item 8 — IFB 61-601-61-1309 opening April 27, 1961 — 1688 lbs. — 366,000 each 4x4 solid for later surface area — 550,000 each 4x4 are qualified products on QPL 7885.

10. 11300 LIGHTING FIXTURES, issued by PURCHASE DIVISION, NAVAL SHIPS GENERAL CENTER, Philadelphia, Pa. — Bid No. 660 Opening April 4, 1961.

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COVER: Two Sud Aviation SE 3200 Frelon helicopters, powered by three Turbomeca free turbines delivering 812 shp. on takeoff, are shown in hovering configuration. Maximum speed of aircraft is reported at 131 kt. and cruising speed 124 kt. Prototype flights have been made above 13,000 ft. Although the aircraft first flew June, 1959, no preproduction orders have been received from the French government. West German Defense Ministry, however, has expressed interest in the French craft (AW Feb. 27, p. 35).

PICTURE CREDITS

Cover—Sud Aviation; 30—Convair; 32—UPI; 33, 109—USAF; 43—Horton & Horton; 45—Sud Aviation; 54, 55 (top)—Messerschmitt AG Augsburg; 55 (bottom)—NATO; 64—Plasmadyne Corp.; 81—FMA, Inc., Electronic Associates Inc.; 87—Aviation Week; 90—Rocketdyne; 93—Bristol Siddeley; 100—Beech; 103—Dassault; 112—Martin; 119—Grumman; 121—Armstrong-Whitworth.

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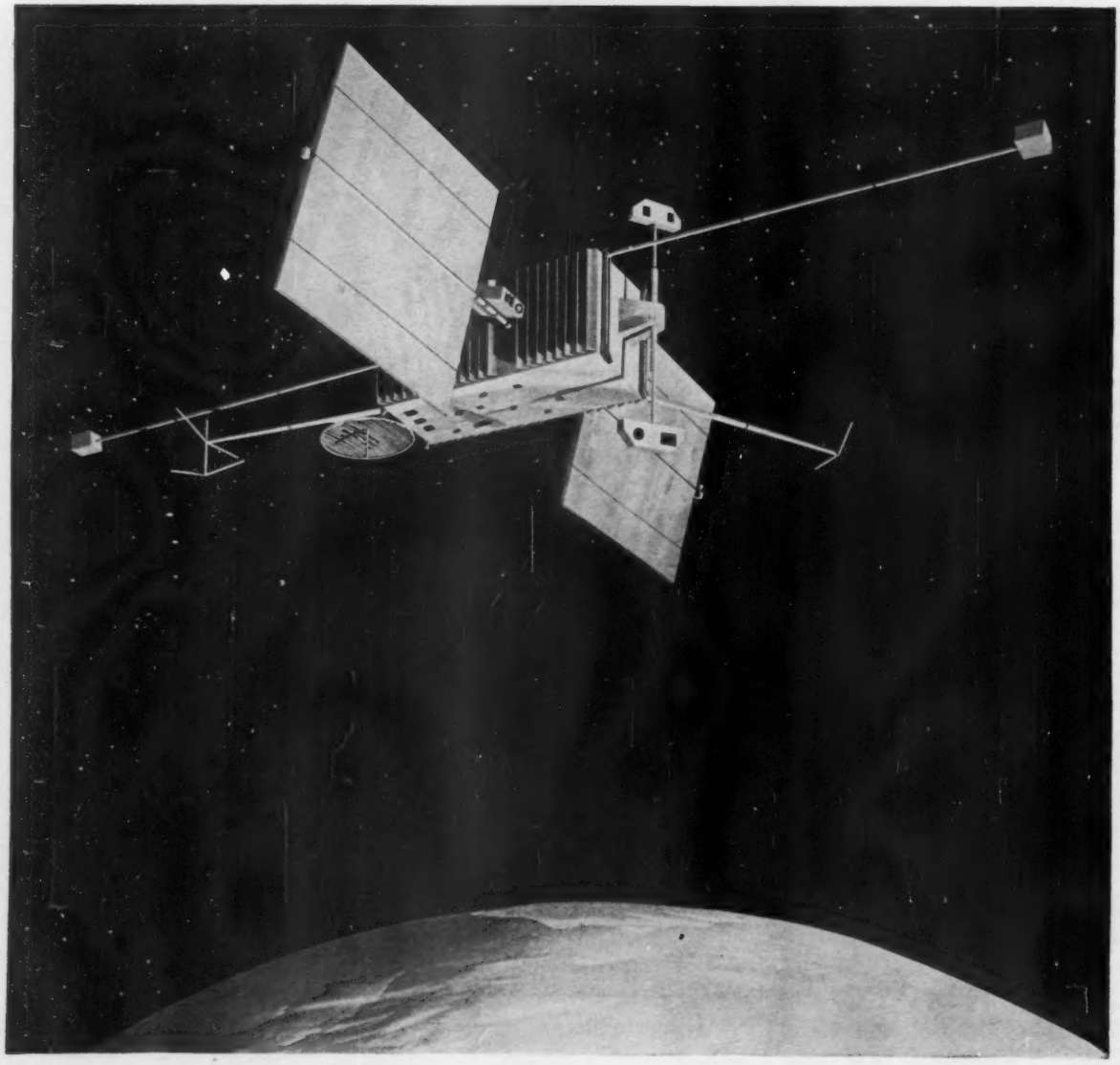


EDITORIAL

The Too Familiar Pattern

With the rumble of Russian-built Stalin tanks only 90 mi. from Miami and Cuban dictator Castro's threat to strafe Florida airfields with Russian-built MiG jet fighters, it may be an appropriate time to look around the world to see just what has happened in critical areas since the January "thaw" in U.S.-USSR relations at the outset of the Kennedy Administration.

At that time, some people hailed the return of the USAF RB-47 flyers as signaling an easing of international tensions and evidence of Soviet willingness to participate in significant negotiations aimed at calming a troubled world. Few people noted that the USAF RB-47 crew had been shot down illegally over international waters, that four of the six-man crew had been murdered by the Soviet fighter pilots and that the two survivors had been held illegally in Soviet jails for many months.

It is an old Soviet technique to gain concessions from its opponents by agreeing to stop doing something it had no right to do in the first place.

Russian Stalling

How has international tension eased since that gesture? Almost every trouble spot in the world has boiled anew under Soviet stimulus. In Laos the Soviets are playing an old, familiar game that should be pretty clear to students of the Korean and Indo-China wars. They started a Russian-supplied invasion of Laos and are now stalling the U.S. and its allies with "cease-fire" negotiations while they pour in military supplies and maneuver into position for a military coup de grace. Only when they have attained their goal of dominating Laos will the Soviets agree to anything. Then any agreement will only serve to ratify their aggressive gains. Once again the perimeter of international Communism will be significantly extended.

We are getting another sample of this familiar pattern of Soviet negotiations in Geneva where the monotony of endless talks over a nuclear test ban is relieved only by the ingenuity of the Soviet delegates in originating new objections to any concrete steps in this direction. In the meantime, critical nuclear weapons development programs in this country are being blocked by our self-imposed voluntary test ban. It will be difficult to increase the warhead yield of Polaris and Minuteman ICBMs without further testing because of the warhead size limitations of these weapons. It will also be difficult to develop the full range of small-yield tactical nuclear weapons for battlefield use without further testing.

The original international campaign against nuclear testing was stimulated by the Soviets on the ground that fallout contamination would poison the world. The fact that most types of nuclear testing can now be carried out underground where there is no fall-out has somehow been obscured by the fog of Soviet propaganda. It must be evident to all concerned that the Soviets have no real interest in either disarmament or nuclear test bans but are simply stalling in any manner they can to delay U. S. weapons development programs that pose a serious threat to their continued plans for aggression.

Feint and Thrust?

With the pots boiling in Laos and Cuba, we wonder how long it will be before the Soviets stir up another trouble spot to absorb our resources before making their key move. Will they get the Berlin pot boiling again before making another major thrust to extend their perimeter into Iran, for example? Most Americans have forgotten that Iran was one of the few places in the post-war world where the Communist perimeter was rolled back and aggression effectively blunted. But the Soviets certainly remember and can be expected to keep Iran on their list for future action. Soviet troops moved into northern Iran shortly after World War II and moved smartly out again after blunt warnings by former President Harry Truman. But in those days we had a monopoly on both the atomic bomb and the aerial delivery system required for reaching long-range targets, and this apparently was language that dictator Stalin understood.

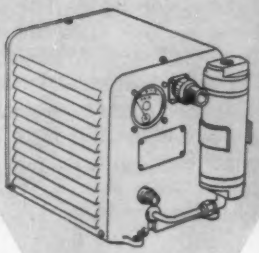
Communist Encroachment

It is high time that the American people understand the pattern that is being developed with the sole purpose of extending the perimeter of Communism and eventually strangling freedom wherever it still persists.

We agree with President Kennedy that military leaders should avoid public discussion of foreign policy. But we strongly disagree that open discussion of the increasingly acute problem of Soviet aggression should be avoided for fear of "offending" the Soviets and spoiling the possibilities of international negotiation. This latter policy serves only the Soviet purpose and again will lull the American people into a false sense of security. In contrast, every event in Laos, Cuba, Geneva, Berlin and outer space in the past few weeks should convince every American of the reality of the menace we face and the need for exerting a national effort to oppose it that is unprecedented in our history as a nation.

—Robert Hotz

FOR GROUND CHECK-OUT



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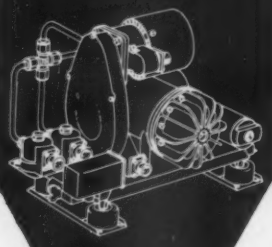

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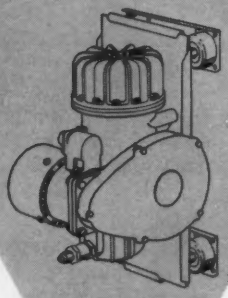

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WHO'S WHERE

In the Front Office

Robert E. Lewis, president and chief executive officer and a director of Perkin-Elmer Corp., Norwalk, Conn., succeeding **Richard S. Perkin,** now board chairman.

H. E. C. de Chassiron, president, D. Napier & Son (Canada) Limited, Montreal, Canada. Mr. de Chassiron is managing director of D. Napier & Son, London, England, succeeding **H. Sammons,** retired.

Jerold C. Hoffberger, Baltimore industrialist, a director of Fairchild Engine and Airplane Corp., Hagerstown, Md.

Dr. Stuart T. Ross, vice president-research and engineering, Brooks & Perkins, Inc., Detroit, Mich.

Dr. Robert M. Fano, a director of Adcole Corp., Cambridge, Mass. Dr. Fano is Professor of Electrical Communication at Massachusetts Institute of Technology.

Itek Corp., Waltham, Mass., has formed Itek Laboratories by joining two company divisions (Hermes Electronics Co. and Information Technology Laboratories) and has appointed the following officers: **John H. Carter,** president; **Malcolm M. Hubbard,** vice president and director of research; **Duncan E. Macdonald,** vice president and chief scientist; **Norman H. Taylor,** vice president and director of special projects.

Robert H. Roy, a director, vanZelm Associates, Baltimore, Md. Mr. Roy is the Dean of the College of Engineering, Johns Hopkins University.

Frank R. Osborne, president, B. H. Hadley, Inc., Los Angeles, Calif., succeeding **B. H. Hadley,** resigned.

Kenneth M. Miller, vice president and general manager, Daystrom-Pacific, Los Angeles, Calif., a division of Daystrom.

William H. Moore, vice president, Military Products Division, Electronic Industries Assn., Washington, D. C.

Ralph H. Ruud, a vice president of North American Aviation, Inc., Los Angeles, Calif., and president of the Los Angeles Division, succeeding **Raymond H. Rice,** on leave of absence.

F. W. Witzke, vice president and chief administrative officer, Cleveland Instrument Co., Cleveland, Ohio, a subsidiary of the Bendix Corp.

James S. Lee, formerly executive vice president of United Aircraft International, has been named assistant sales manager of Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn.

Guy H. Hearon and **Walter E. Brown,** vice presidents of Benson-Lehner Corp., Santa Monica, Calif. Messrs. Hearon and Brown are executives of the Photo Instruments Division and Field Services Engineering, respectively.

Dr. Leonard S. Sheingold, chief scientist of the United States Air Force succeeding **Dr. Alexander H. Flax,** who will return to Cornell Aeronautical Laboratory as vice president and technical adviser. Dr. Sheingold is director of the Applied Research Laboratory of Sylvania Electric Products.

Lt. Col. John R. F. Bond, executive officer of Redstone Arsenal, Huntsville, Ala., and **Lt. Col. Stanley L. Nyhan,** assistant for personnel.

(Continued on page 125)

INDUSTRY OBSERVER

► Air Force Space Systems Division has asked Martin to establish stability of its definitive configuration for the advanced Samos E-6 recovery capsule with scale-model wind tunnel tests at National Aeronautics and Space Administration's Lewis Research Center. Parallel E-6 development is being pushed rapidly at General Electric's Missile and Space Vehicle Department. Capsules, projected for parachute recovery over land, are not expected to be used operationally before early 1963.

► **Companies interested in bidding on the Apollo spacecraft project will be invited to a conference to be held July 15 by NASA. Current study contractors are to report May 15, and the results will be used to write specifications to present at the July meeting.**

► USAF now has decided to limit Project Bambi ballistic missile boost intercept study to the two contractors already chosen—Convair and Space Technology Laboratories (AW Apr. 10, p. 34). Air Force originally planned a third study, but competing companies have been told there will be none. Funding for the project also may be reduced as a result of Advanced Research Projects Agency-USAF differences over whether research and development goals should be stressed in the near future.

► **Air Force will substitute nitrogen tetroxide for inhibited red fuming nitric acid as the oxidizer in future Agena B flights. Fuel remains unsymmetrical dimethylhydrazine (UDMH). Switch was made because of nitrogen tetroxide's higher specific impulse when burned with UDMH and because its greater density provides more oxidizer per pound.**

► First launch of USAF-Martin Titan I test vehicle directly from a silo tentatively is scheduled from Vandenberg AFB May 3. Silo Launch Test Facility is about 140-ft. deep and has dual ducts which slant down and then up to bleed off exhaust gas. Silo and exhaust duct walls are lined with heat-resistant noise-damping material which is designed to minimize vibration effects which otherwise might severely damage or destroy the missile as it leaves the silo.

► **Means of defending against lethal offensive and environmental hazards which space vehicles might meet in earth orbit or while maneuvering in irregular trajectories are being analyzed by Air Force's Aeronautical Systems Division in anticipation of the hazards of future tactical missions in space.**

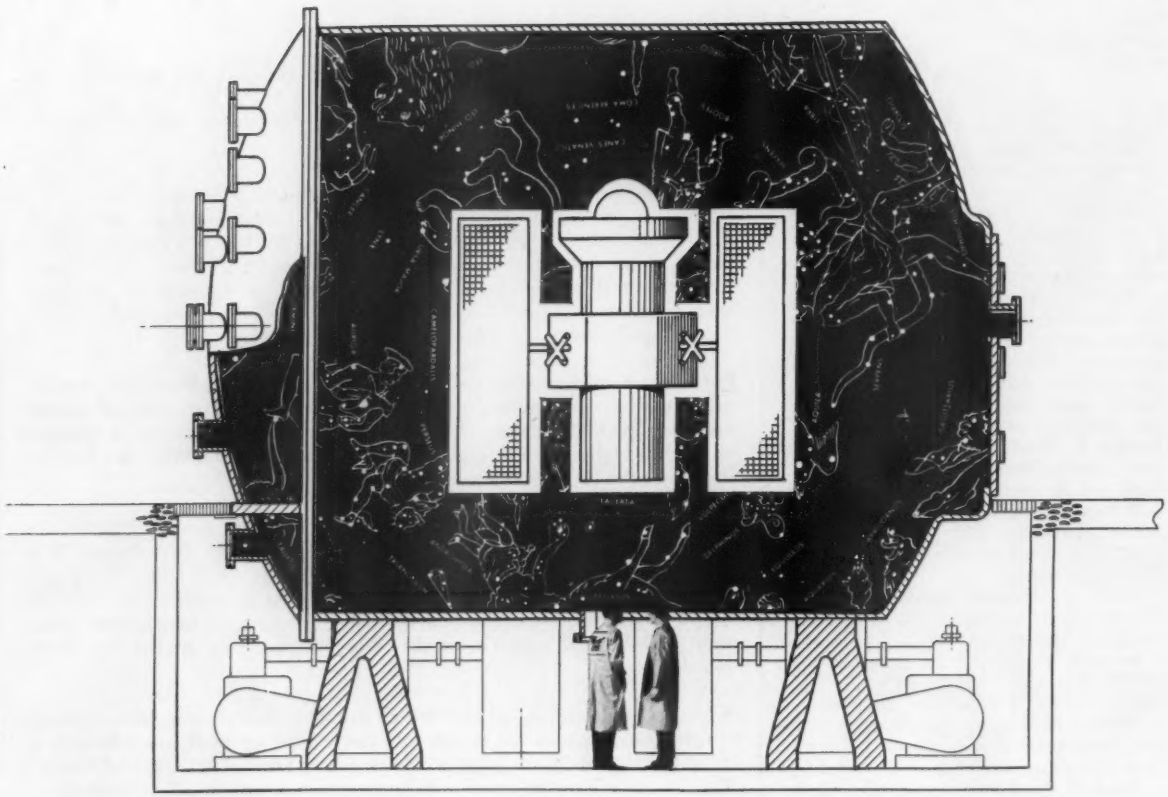
► New interferometer type of spectrometer for analyzing infrared radiation, with a sensitivity 1,000 times greater than conventional devices, has been developed by Block Associates, Cambridge, Mass., for Air Force Cambridge Research Laboratories.

► **Proposals for design study of Prospector, a mobile, soft-landing lunar vehicle, probably will be submitted to NASA's Jet Propulsion Laboratory late next month or early in June.**

► Douglas is proposing analysis of a ground effect vehicle and development of a prototype machine to Office of Naval Research. Douglas says the vehicle is expected to have commercial possibilities along with its military tactical application.

► **Feasibility study of converting urine to potable water through alternate freezing and melting will be supported by the Air Force Aeronautical Systems Division. Aimed at providing water for space crews, this zone refining approach calls for using a moving heat source to melt small areas of a column of frozen urine.**

► Navy's David Taylor Model Basin plans to use the reopened hydrodynamic research facilities at NASA's Langley Research Center for research and development programs concerning hydrofoils, air cushion vehicles, hydro-skis, planing catamarans, steep-takeoff-and-landing seaplanes, torpedoes and underwater rockets.



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Washington Roundup

Agitation for Overtime

Latest signs of a growing impatience with the relative U. S. position in space exploration include agitation by some top National Aeronautics and Space Administration officials for a longer work week—44 hr. at first and later 48 hr.

Since the agency was formed two and a half years ago, key management and technical personnel have often worked much longer weeks than that. But legal restrictions keep them from asking support personnel to go beyond a 40-hr. week. This dilutes the effect of the management overtime that is put in.

NASA would need more money in salaries and expenses across the board to keep computer operators, technicians, secretaries and others on the job for more than 40 hr. Meanwhile, Congress continues to needle the agency about lacking a sense of urgency, and the Kennedy Administration is continuing the Eisenhower policy of granting top priority—which also means unlimited overtime money—only to the Mercury and Saturn programs.

The three-year-old argument that the U. S. lag in space spectaculars is not important because of the U. S. lead in space science no longer is selling well on Capitol Hill. Although dissatisfaction could die down again if Russia does not make another manned flight soon, there are strong indications that some new theme will have to replace the science-vs.-spectaculars explanation if Congress is to refrain from forcing more money on the Administration for space work (see p. 31).

Dr. Frank Press, who is a member of the President's Science Advisory Committee and a California Institute of Technology geophysicist, told a group of newspaper editors here last week that manned space flight is "one field where we have got to do our best" to excel Russia. He said Maj. Yuri Gagarin's orbital flight may have had little scientific significance, "but we can't write this thing off by saying it wasn't science." Dr. Press also said "we cannot afford to be behind" in large rocket boosters. In the past, Science Advisory Committee has been the stronghold of those who argued science vs. the spectacular and those who were lukewarm on manned space flight.

B-47 Postponement

Joint Chiefs of Staff decided last week to recommend a one-year postponement in the phasing out of USAF B-47 medium bomber wings because of the unreliable circular error probability of operational Atlas missiles launched so far and the poor record of Polaris missile launches from submerged submarines. At the time the decision was made, the Polaris record was 10 successes in 18 shots. By late last week, two fixes had been made on the missiles and the record had climbed to 12 successes in 20 shots. B-47 phasedown from 20 to 13 wings by the end of June will not be halted, but further phasedown will be suspended if the JCS recommendation is accepted.

JCS has completed a staff study that would permit it to review proposed weapon systems from a research and engineering standpoint before they go to the Defense research and engineering office. This probably is a result of recent criticism that the Joint Chiefs were not being consulted by their civilian superiors. Review power would not require a noticeable increase in the size of the Joint Staff. It already stands at 900, about one-third civilians.

President Kennedy has asked the Budget Bureau to revise travel regulations so **they give U. S. flag carriers preference** for all government-financed travel. State and Defense Departments already require civilian employes to favor U. S. lines. Sen. Warren Magnuson estimates that the government finances $100 million in travel annually.

Regulatory Control

The President will soon send to Congress recommendations for centralizing managerial functions of federal regulatory agencies. He already has asked Congress to strengthen the role of agency chairmen as a step toward tighter control of agency functions. Specifically, he wants more authority for chairmen to staff agencies subject to Civil Service requirements; form organizational patterns, review budget estimates and allocate funds within each agency according to the agency's major aims and purposes. The President also emphasized that the chairmen should be directly responsible to him.

Rep. Stephen B. Derounian has introduced a bill that could kill development of a supersonic transport. The New York Republican represents a district near La Guardia and Idlewild airports and is a strong critic of aircraft noise. His bill would require Federal Aviation Agency to preclude use of any aircraft in commercial service that could exceed speeds of current aircraft. Rep. Derounian said he wrote the bill after FAA Administrator Najeeb Halaby asked Congress for $10 million for supersonic transport development. The money should be spent to solve existing airline safety problems before "creating other problems," Rep. Derounian said.

—Washington Staff

Industry Shapes Supersonic Design Goals

IATA conference concludes supersonic airliners are technically feasible but economically undefined.

By David A. Anderton

Montreal, Que.—Broad specifications for supersonic transports, now generally accepted as inevitable by the early 1970s, began to take shape here last week at the 14th Technical Conference of the International Air Transport Assn.

Such transports will be about the geometric size of today's jets but will weigh approximately 400,000 lb. They will seat about 130 passengers, probably in all-coach configuration, carry them over stage lengths initially of 3,500 naut. mi., with growth to serve longer routes built into the design. Cruise speeds will be on the order of Mach 3 and altitudes will approximate 75,000 ft. In holding patterns, approaches and landings, over-all performance will equal or better today's transports.

This first official exposure of operators to designers has helped immeasurably to narrow gaps between groups and to give both new appreciation of each other's problems.

For old hands at the game of designing transports to match the requirements of the world's airlines, this meeting provided new detailed factors that had to be fed into their project teams.

For relative newcomers to the field of supersonic transportation, this meeting provided a series of factual inputs that gave more useful information than dozens of trips into the field.

Basic conclusion of the Technical Conference was that supersonic transports are technically feasible, but economically undefined.

"We think we know how to build them," said one engineer, "but we haven't the faintest idea about seat-mile costs."

Costs Not Defined

For airlines, this all-important parameter of seat-mile costs never did get defined thoroughly. About the best approach was a general agreement among old-line suppliers of the world's transports that costs would be comparable to today's values. But several engineers said it was premature to think in terms of seat-mile costs and that the conference should consider airplane costs per mile.

Actually this conference tried to define in technical terms broad specifications for supersonic transport. Broad concepts, both in a configuration and operation sense, began to show through the front of detailed questions and answers that sometimes seemed to obscure the general picture, but what it boiled down to was this: Airline operators—with very few exceptions—wanted a profitable airplane about the size and capacity of today's subsonic jets, capable of using the same runways and airport facilities, and having low-speed performance either equal to or better than the current generation of jet transports.

Users wanted to be able to buy these airplanes, operate them profitably, and write them off over a time span of at least 10 years. In some cases, considerably longer useful life, up to 20 years, was mentioned.

Servicing Requirements

They wanted these airplanes to be simple to maintain and easy to repair. There were to be no new problems of passenger loading, refueling or ramp positioning, and while they were willing to pay a premium initial cost for an airplane with the tremendous productivity of a supersonic transport, they definitely would not put up with a premium price for the necessities of the airplane's everyday life. Fuel costs worried the airlines, who said that in the case of a supersonic transport, they were half of the direct operating cost figures.

Complexities of automatic checkout equipment, which in the airlines' equation could equal lost money, also worried them.

Manufacturers were willing to meet most points with occasional and expected compromise. Their concern was with the price airlines were willing to pay for premium performance.

Most compromises of cost versus performance could be expected to show in the low-speed flight regime, they indicated. If airlines wanted pattern, approach and landing speeds equal to today's Boeing and Douglas jets, that was possible at little premium. But if these speeds had to be lower—and there was considerable support for that case—then the price had to be paid. The price was the cost of providing extra aerodynamic and structural trickery of variable geometry or boundary layer control that would give these Mach 3 aircraft the capabilities of a Douglas DC-6 in circuit.

Technically it looks like a long way from the configuration studies of NASA, which feature variable sweepback, to some of the fixed geometries of manufacturers. "With all due respect to John Stack," said one designer, "I wish he had to design a complete airplane instead of just getting the best ideas in the world for aerodynamic configurations."

But Stack himself is the first to point out that there is no technical monopoly in NASA studies showing variable sweep as one method of licking low-speed problems. He said North American Aviation is working in the right direction by using drooping wingtips. They give additional directional stability at supersonic speeds where needed and increased aspect ratio at landing speeds.

Most manufacturers agreed that variable geometry of some sort was a necessity, but then were careful to emphasize that variable geometry did not necessarily mean variable sweep. "We've used variable geometry for years," said a project engineer, "and the flaps work pretty well. We're thinking now of engine inlets, for example, and vertical and horizontal tails."

Most designers felt variable sweep was not their best choice and one cited the waste of usable volume for fuel that would be the result of accommodation of the hinged root section on a variable sweep wing. But none of them would categorically rule out any geometric changes in the airplane now for any reason, preferring to wait until the project had considerably more study time behind it.

But although they agreed on variable geometry and the provision of good low-speed performance, there were as many disagreements about the way to design the airplane as there were designers.

Supersonic Projects

Current inventory of supersonic transport projects shows a total of eight, including five from the U. S., two from Great Britain and one from France. In the U. S., old-line transport companies such as Boeing, Convair, Douglas and Lockheed have been joined by tough newcomer North American Aviation. In England, British Aircraft Corp. is combining the talents of Vickers and English Electric in a powerful team effort aimed at beating out the Hawker Siddeley entry, and in France the technically competent team of Sud Aviation and Dassault is a dark horse in the race, drawing heavily on the supersonic expe-

rience of Dassault, the size and encompassed talents in Sud Aviation plus the unique experience of Nord Aviation with flight tests of a combined turboramjet powerplant in a Mach 2 Griffon aircraft.

None of these teams is underrated by the competition. "Remember, we never took the Caravelle seriously until it was too late," said one American sales engineer. "The French could have some intriguing answers again."

But whether the supersonic transport of the 1970s bears an American, British or French nameplate, it will have to meet criteria hammered out here and at later similar meetings by airline users of the world. Ultimately there is one criterion for judging the success of a supersonic transport, said Sir William Hildred, director general of IATA, in opening this meeting, and that, he said, is the price of the ticket.

First Centaur Flight Delayed Six Months

Washington—First Centaur launch date has been delayed six months to November because of a faulty ignition system which caused three test stand explosions at the Pratt & Whitney Florida facility, Maj. Gen. Don R. Ostrander told the House space committee last week.

Gen. Ostrander, director of National Aeronautics and Space Administration launch vehicle programs, said redesign of valve timing and injector of the LR-115 liquid oxygen-liquid hydrogen engine has been necessary because the original system injected an improper mixture which produced "a ball of hydrogen" around the sparkplug igniter.

NASA has shuffled its liquid hydrogen-liquid oxygen engine program to emphasize the 15,000-lb. thrust configuration for Centaur and Saturn. Last week, the agency's contract with Pratt & Whitney for development of the LR-119 engine had not been canceled (AW Apr. 17, p. 39). The uprated engine, which would develop 17,500 lb. thrust, has no present application since it was replaced by the LR-115 in Saturn C-1 and C-2 upper stages.

The Kennedy budget added $25.6 million to accelerate development of the Centaur vehicle (see photo p. 30), most of which now will go to the LR-115 engine. NASA's other hydrogen-oxygen engine, the 200,000-lb. Rocketdyne J-2, received an additional $56 million in the new budget. Cluster of four J-2 engines will power the second stage of the Saturn C-2.

Pratt & Whitney plans to continue product improvement on an uprated hydrogen-oxygen engine to increase both thrust and specific impulse of the LR-115.

U.S. Offers Canadian Production Of F-104s for Greece, Turkey

Washington—Negotiations for production of about 300 Lockheed F-104s in Canada, to implement an agreement between President Kennedy and Canadian Prime Minister John G. Diefenbaker, will enter another round late this week in Ottawa.

If they go into production, the 300 fighters will be given to Greece and Turkey under the U.S. Mutual Defense Assistance Program. They will be ordered in addition to the CF-104s Canada is building for its own use.

The plan is a major concession to Canadian arguments that the U.S. has not paid enough attention to the official policy of an even exchange in weapon procurement between the two countries. Difficult problems remain to be solved in deciding which companies would build engines, electronic equipment and airframe subassemblies. Production declines in both the U.S. and Canadian airframe industries have created political pressures which are making negotiations sensitive.

Canada, which had tied its U.S. sales hopes to the Canadair CL-44 cargo transport, was left with little prospect for future airframe production when the U.S. decided to buy C-135s and C-130s for its interim airlift needs. Canadair is the only major airframe manufacturer remaining active in Canada since Avro Aircraft, Ltd., was drastically reduced in size when the government decided to cancel production of the CF-105 interceptor.

Lockheed has a sizable F-104 production program of its own and has substantial contracts for the C-130 and C-141 cargo transports and the Polaris missile. This would cushion the impact of losing further production to Canada. General Electric, which furnishes the F-104's J79 engines, could be adversely affected in the Cincinnati, Ohio, area where it has its engine plants. It was hit recently by the cancellation of the nuclear-powered aircraft program.

The F-104 intended for MDAP use is essentially the same as the F-104G which is being assembled in Germany for some of the North Atlantic Treaty Organization nations. It will be capable of both air-to-air and air-to-ground missions, unlike the CF-104 which is primarily for air-to-ground work.

The MDAP F-104 will differ from the F-104G in some details, with different size wheels and tire imprint areas. It is to carry the F-15A North American Search and Ranging Radar NASARR, which can perform the dual mission role. The CF-104 carries an R-24-A radar.

Gunsights differ also, with the F-104G and the MDAP F-104 requiring a computing gunsight. The CF-104 uses an optical gunsight.

In addition to the CL-44 and the CF-105, the Canadians feel that other designs of theirs have been overlooked. Another aircraft mentioned is the Argus anti-submarine aircraft. They point out that they have been purchasing U. S.-built aircraft, including the DC-8 for Trans-Canada Airlines, and they feel the aircraft economic flow has been one way.

F-104 production in other than MDAP programs, called Mutual Security Military Sales, is expected to reach 1,500 in European production, costing almost $2 billion by 1965.

West Germany is producing the complete F-104G, using components made in Europe augmented by some parts from the U.S., for the Organization for Direction and Control (ODC). Represented in ODC are West Germany, The Netherlands, Belgium and Italy.

The decision to produce MDAP aircraft in Canada will have an impact on the European ODC operation, which had hoped for the business.

F-105 Close Support Demonstrated by USAF

Tactical troop support capabilities of the Republic F-105 fighter-bomber were put on trial last week as top officers of the Army and Air Force watched joint maneuvers in the area near Nellis AFB, Las Vegas, Nev.

The demonstration was the result of recent criticism of the close support role of high performance aircraft, including the F-105 and the North American F-100, claiming they could not operate from unimproved airstrips, are not fitted for delivery of conventional weapons and are too sophisticated and expensive.

Marine Corps and the Navy plan to match the Air Force show with a similar demonstration Apr. 26 in the area of the Cherry Point, N. C., Marine Corps Air Station.

A Vertol H-21 helicopter crashed just after takeoff during the Nellis AFB demonstration, and blade fragments killed Col. Wayne E. Downing, assistant for aviation in the Requirements Division of Air Force deputy chief of staff-logistics, and USAF Lt. Fred D. Wolf, who were standing on the helicopter pad. H-21 passengers and crew were not injured.

Douglas Cites Recovery Prospects; Stockholders Critical of Report

Los Angeles—After two loss-years, Douglas Aircraft Co. is headed toward recovery, Chairman Donald W. Douglas, Sr., told 1,100 stockholders at the annual meeting here, but there was dissent from some of the individual stockholders.

The company reported a profit for the second consecutive quarter, but no cash dividends are to be paid because of restrictive provisions in Douglas' long-term debentures. A stockholder rose to say that according to his interpretation of the annual report, no dividend would be possible for two or three more years.

Donald Douglas, Jr., president of the company, said many factors could affect the date at which a dividend will be possible.

For the first quarter of Fiscal 1961, which ended Feb. 28, the company reported a net profit of $1,715,000.

Sales were $204,868,000 compared with $251,519,000 for the first quarter of 1960. Profit on the 3,816,000 shares presently outstanding was 45 cents compared with a loss of $1.82 a year earlier.

Total backlog at the end of the quarter was $879,707,000, of which $646,118,000 or 73% was government work and $233,589,000 or 27% was commercial. Backlog a year ago was $1,413,363,000, with $746,245,000 or 52.8% government work and $677,118,000 or 47.2% commercial.

Two new directors, Charles R. Able and Jackson R. McGowen, were elected. Able is vice president-defense programs and McGowen is vice president-commercial programs.

Corrective Measures

Douglas cited cost-cutting and diversification maneuvers that the company is making to improve its profit-loss position. He said that about 1,000 employes have been transferred from the company's Santa Monica Division to the Long Beach plant in order to centralize all transport activities there. Missile and Space System engineering personnel are being centralized at the company's Culver City facility. Missile production will be retained at the Santa Monica facility.

Douglas said the company is attempting to buy areas of the Long Beach plant which still belong to Air Force and sell other areas which are no longer needed. Air Force is reported to be interested in taking over the publications and simulator facility at Lawndale, Calif., to make room for expansion of USAF's Arbor Vitae complex housing the Ballistic Missile Systems Division and the Space Systems Division which, before recent reorganization of the service (AW Mar. 27, p. 22), were both part of the Ballistic Missile Division.

While the transition from a great deal of long-run production work to an emphasis on short-run scientific research and development makes it difficult to control overhead costs, "we believe Douglas overhead bidding rates are among the lowest in the aerospace industry," Douglas said.

Critical stockholders denied this. One reported he had heard that Douglas lost the SOR-182 jet transport competition because its unit price was $1 million above the Lockheed price. Another said that in 1951, Douglas sales were only a quarter of last year's sales but the company was able to show a $7-million profit. He called for a reduction in costs.

Chairman Douglas replied that there was not such a wide disparity between the Douglas and Lockheed prices for SOR-182 and predicted that Lockheed would "lose considerable money" on it if USAF fails to buy enough change orders to let the company equalize price and cost.

Layoffs Anticipated

Company President Donald Douglas, Jr., said there will be more layoffs at Douglas, mostly in the Long Beach plant, but that employment will soon level off. He said the trend cannot start upward again until after substantial DC-8 reorders or major new contracts. "Unhappily, it would be two or three years in the future," he said. President Douglas pointed out that Long Beach is one of the few facilities in the country in which both the plant and the airfield could handle a supersonic transport.

He said that the company has been disappointed by slow sales for the DC-8 and the Sud Caravelle but has hopes for an upturn in the future.

Commenting on changes in the business, Douglas noted that engineers have risen from 6% of the company population to 23% in the past few years and that the proportion will probably rise to 33% in the next few years. Douglas clashed with one stockholder on the company's pace of diversification. The stockholder won applause when he called for more and quicker diversification and suggested that the company might revive its interest in boats. Douglas, Sr., said that he saw no profit in the boat business but pointed out that the company is actively trying to sell paper honeycomb, trade-named Aircomb, to the homebuilding industry.

NAA Aid Requested

Washington—Congress has been asked to authorize a $450,000 appropriation to the Secretary of Defense to help the National Aeronautic Assn. finance world aviation championships and a General 1962 Conference of Federation Aeronautique Internationale in the U. S.

The championships and conference would be held in conjunction with the Air Force Assn.'s World Congress of Flight at Las Vegas, Nev., Sept. 16-23. NAA will handle the general aviation portion of the congress regardless of whether the bill passes, but a spokesman said NAA cannot play host to the championships and conference without aid.

The bill was introduced by Rep. Olin Teague (D.-Tex.) at the request of Jacqueline Cochran, former president of FAI. It has been referred to the House Armed Services Committee for action, and the committee has asked Defense Department for its comments. The bill would provide that the secretary furnish assistance for the championships, the conference "and for other purposes."

Championship events would include gliding, aerobatics, model aircraft flights, parachuting and ballooning.

Reduced 1962 Cessna Earnings Forecast

Cessna Aircraft Co. sales and earnings will not meet last year's level, President Dwane L. Wallace told stockholders after a meeting of the board of directors at which results of first six months of Fiscal 1962 were revealed.

Indications were that business aircraft sales, although experiencing a "slight pickup," were still affected by general recession conditions to the point where a more favorable prediction of year-end results could not be made at this time. Although official industry-wide figures are not yet available, indications are that March—generally a month of high deliveries—did not show a significant upturn from the declines experienced in January and February, at which point the industry was behind some 327 units and approximately $5.2 million in factory billings compared with the same period last year.

Cessna reported that for the first six months of its Fiscal 1962 period, total sales were $47,573,000 compared with $57,314,000 in the same period for Fiscal 1961. Commercial sales for the first six months recently ended were $27.7 million compared with $30,664,000 for the same period last year. Earnings for the first half of Fiscal 1962 were 99 cents per share compared with $1.31 in the first half of last year.

The company announced it would pay its regular quarterly cash dividend of 25 cents May 16th.

Explorer X Maps Solar Magnetic Lines

Washington—Explorer X has provided "fantastically clean" data on earth and interplanetary magnetic fields which support the theory that solar winds are strong and relatively stable at distances at least to 145,000 mi. from the earth, the limit of the satellite's measurements.

From preliminary findings representing about six of the 60 hr. of data provided by the magnetometer payload, the National Aeronautics and Space Administration has mapped solar magnetic lines which are nearly radial away from the sun and are composed of streams of particles which impinge at high velocity on the earth's magnetic field at altitudes ranging from 52,000 to 100,000 mi. above the earth's surface.

Dr. Charles Sonett, chief of NASA's science, lunar and planetary programs, said a knowledge of the "plasma wars" in magnetic fields could lead to understanding of controlled thermonuclear fusion on the earth.

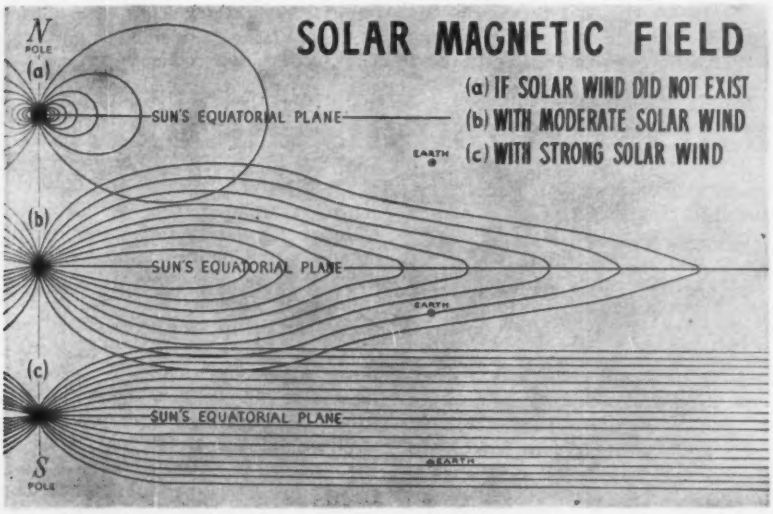
The 78-lb. package was launched into a highly elliptical orbit Mar. 25 (AW Apr. 3, p. 32) and encountered magnetism in interplanetary space ranging in strength from 20-32 gammas. Strongest field measured by the Pioneer V probe at 125,000 mi. altitude was 2.7 gammas. A gamma is about 0.05 of the magnetism on the surface of the earth.

The satellite, which was useful as a scientific instrument during its 60 hr. of transmitting time, is still in an orbit with a 100-mi. perigee and 145,000-mi. apogee.

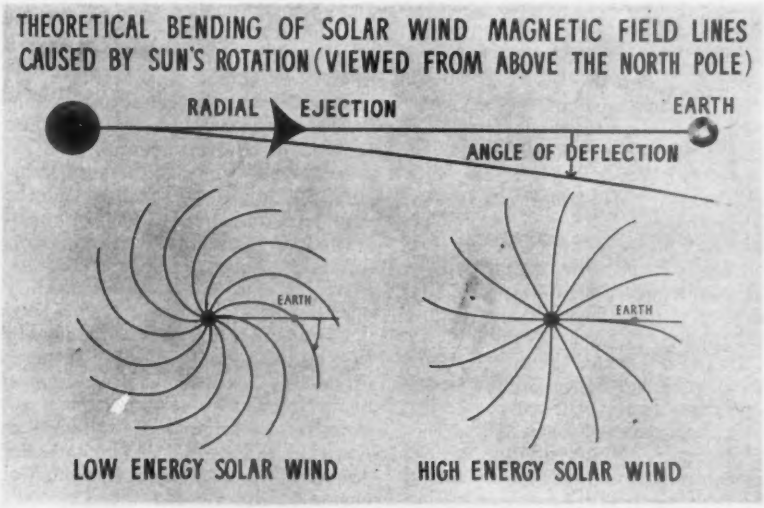
Significant preliminary measurements made over portions of the trajectory include:

- **First sampling** of the density and velocity of solar protons. In the relatively stable state, it was found that solar winds contain 10 particles per cubic centimeter and travel at a velocity of about 610,000 mph. Velocity increased to 3.62 million mph. after a solar flare which occurred Mar. 26.
- **First confirmation** of the exact timing of a "sudden commencement"—the term describing impingement of protons on the earth from a solar flare. About two minutes after the bombardment was registered on the earth, it was recorded by the satellite, which was approximately 146,000 mi. farther away from the sun. Shock wave was observed on earth 28 hr., 26 min. after the flare was seen erupting on the sun.
- **Violent agitation** of the interplanetary magnetic field was recorded by the satellite instruments about five hours before the Mar. 26 solar flare, but additional study must be made to relate and possibly predict solar storms on the basis of interplanetary plasma disturbances. Gamma strength during the flare varied from 5 to 40.

Explorer X instrumentation performed normally during most of the flight. The rubidium vapor magnetometer stopped operating at an altitude of 68,000 mi. because it became too hot after its coating was contaminated by rocket exhaust.



Detailed analysis of Explorer X data is expected to provide a map of the solar magnetic lines of force. Preliminary findings using about 10% of available data indicate a high energy, relatively stable wind emitted from the sun in lines of force nearly parallel.

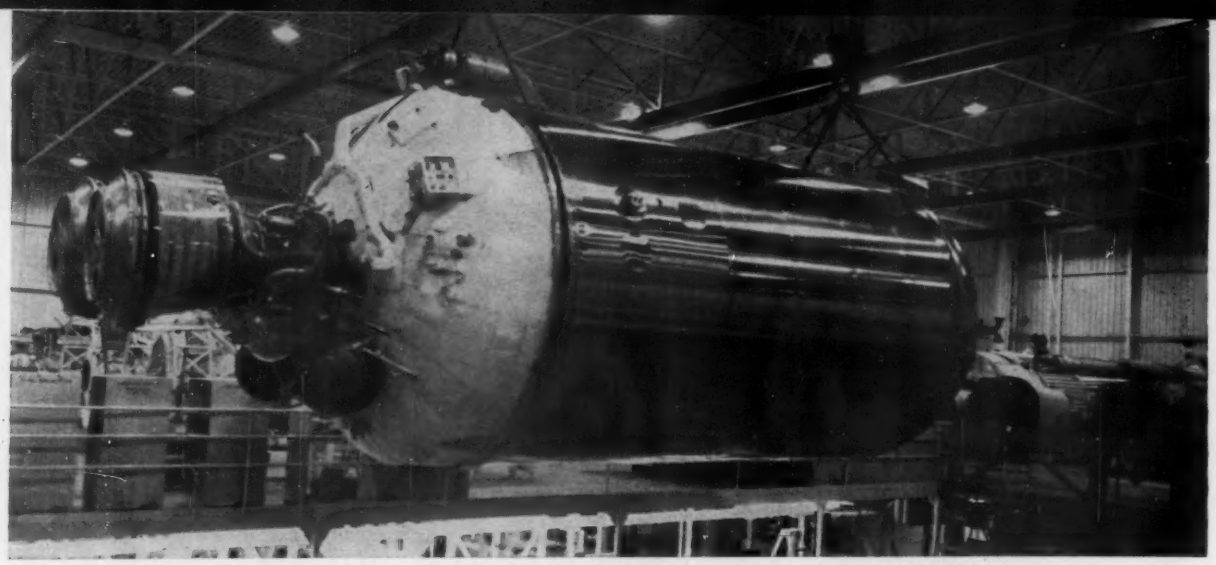

THEORETICAL BENDING OF SOLAR WIND MAGNETIC FIELD LINES CAUSED BY SUN'S ROTATION (VIEWED FROM ABOVE THE NORTH POLE)
RADIAL EJECTION
EARTH
ANGLE OF DEFLECTION
EARTH
EARTH
LOW ENERGY SOLAR WIND
HIGH ENERGY SOLAR WIND

Air Sampling Project Reveals Sulfur Layer

Washington—Three-mile-thick aerosol layer around the earth, 85% of it sulfur particles, has been discovered in a series of balloon and aircraft flights in an air sampling project being conducted by the Air Force Cambridge Research Laboratories.

The layer, which begins at an altitude of 11 mi., is thought to scatter sunlight and cause the red glow seen at sunrise and sunset. USAF Office of Aerospace Research began the project last year and has found uniform sulfur layer distributions between 11-14 mi. in flights ranging from Texas to Alaska to Australia.

In another air sampling project, the National Aeronautics and Space Administration and the Italian Government last week began simultaneous Nike-Asp launches of aluminum thermite clouds (AW Apr. 10, p. 33) to determine geographic variations in high altitude wind activity. Series of three launches was planned from Wallops Island, Va., and Sardinia.



First Photo of NASA-Convair Centaur Vehicle

First photo of a complete Convair Centaur upper stage, which will be used with the Convair Atlas-D booster and in some Saturn configurations to launch a variety of military and scientific space payloads. National Aeronautics and Space Administration plans to make the first Atlas-Centaur launching next November and to use at least 15 Atlas-Centaurs by the end of 1964 in a joint program with USAF. Vehicle is shown at Convair-Astronautics' San Diego plant. Centaur is powered by two 15,000 lb. thrust Pratt & Whitney LR-115 liquid hydrogen engines. A flight model of the Centaur stage already has undergone vertical mating tests with the modified Atlas booster at Cape Canaveral. Launch complex will have two pads, and other Atlas pads there may be modified to accommodate Centaur.

Army Needs Faster Reconnaissance Data

Washington—Army has growing need for instant transmission of battlefield information in simple form to a ground commander while aircraft are performing their reconnaissance missions.

No longer can a decision await the return of an aircraft and the processing of film, industry panel members told the Institute of Aerospace Sciences' National Army Aviation Meeting. In an immediate battle area, which can extend as far as 300 mi., intelligence data must be available quickly in easily used form.

With the addition of its own aircraft, such as the Grumman AO-1 Mohawk, the Army hopes to fill a void which it now considers serious. One pressing need is for target information for operations with the surface-to-surface Pershing missile, which would be aimed at command posts and mobile targets.

When such information is received, it must be simple and easy to interpret. Human factors must be taken into account, with the understanding that semi-trained personnel must be used for photographic interpretation. Methods for training these people were studied by Boeing Aircraft Co., which evaluated 10 methods of teaching recognition of complex forms and of changes in pictorial data.

New cockpit designs, more precise navigation aids and terrain avoidance radar will be prime requirements for aircraft of the future, the panelists said.

Considering Army rotary wing needs for the period 1970-80, comparisons were made between aerial jeeps and helicopters. A continuing need for the rotary wing aircraft was forecast because this type is more economical for vertical rise operations.

The helicopter is limited to about 190-kt. forward speed because of the stall characteristics of retreating blades. The compound helicopter, however, which would have wings and would unload the rotor and perhaps stow it for forward flight, shows promise for speeds of 250 kt. using turbofans and lift fans.

For short, heavy hauls, helicopters will probably use the hot rotor system, which ducts exhaust gases to the rotor tips. The cold rotor ducting system, which burns fuel at the tips, is much less economical in fuel consumption. For conventional longer range hauling, the shaft-driven helicopter will remain the favored configuration. The hot rotor also would be used for the compound aircraft.

For hovering missions, the helicopter is expected to remain the most efficient vehicle. Efficiency decreases as the downstream velocity increases with vehicles using fans and jets vented downward.

It was predicted that the big step forward in rotary wing aircraft will be the compound configuration, but that advances also will be made in structures and engines.

Studies conducted by the National Aeronautics and Space Administration on various flying platforms controlled by a single passenger showed that they are basically unstable. These vehicles are controllable both by movements of the body, as in shifting weight instinctively (kinesthetic control) and by stick control, as in an aircraft. Test subjects who were experienced pilots preferred the stick system, while non-pilot opinion divided evenly on the two systems.

Ground effect machines, which use the air cushion principle to expend less energy for remaining airborne than conventional aircraft, have been studied to incorporate aerodynamic shapes in order to achieve greater forward speeds. Instead of the current 15-17 kt., 200 kt. is considered possible with this system.

For the 1970-80 period, panelists envisioned fixed wing aircraft for the Army as being all turbine-powered, using pods instead of fuselages to carry their loads. Short takeoff and landing performance would be enhanced by use of boundary layer control, probably by blowing air over the flap area to retain smooth air flow at high angles of attack. Other systems employing suction involve considerable plumbing and are believed to be uneconomical.

Need for a "gap filler" assault transport was expressed. Panelists said the Army needs an aircraft which will operate in the area between the high performance strategic airlift of the Air Force and the aircraft the Army now operates.

Discussing future engines for aircraft, they said the Army will have to "pick up the ball" on small engines. Improvements forecast for turbine engines are expected to bring fuel consumption down to 0.3 or 0.2 lb./hp./hr. and weight down to 5 hp. per pound of engine weight.

First Orbital Mercury Shot Set This Week

By Edward H. Kolcum

Washington—United States plans to orbit an instrumented Mercury capsule this week, while Congress is virtually offering a blank check to accelerate the civilian man-in-space program so a lunar landing can be made by 1967.

The House Committee on Science and Astronautics, spurred by the orbital flight of Soviet air force Maj. Yuri A. Gagarin, urged the National Aeronautics and Space Administration to "tell us what you need . . . and we will help you get it."

Dr. Robert C. Seamans, Jr., associate NASA administrator, responded to searching committee questioning by estimating that in an all-out effort the U.S. could send a man to the moon in six years instead of the 9-10 yr.—in the present plan, but the cost could run as high as $40 billion—$8-$10 billion more than with the longer schedule.

The orbital Mercury shot, under consideration for some time as an alternative to the original injection abort profile, will be flown as the third Atlas-boosted Mercury test (MA-3) and will compress several experiments into one. The capsule will be designed to test capsule and ground communications and command frequencies, check out ground tracking stations, and fly an insertion abort trajectory after it completes one orbit. It will be the first Mercury capsule to go on a satellite mission.

MA-3 originally was planned to reach orbit velocity and altitude, then to immediately re-enter about 3,000 mi. down range, simulating an abort at the moment of orbital injection.

NASA said it is not known if a successful MA-3, with the new test objectives, can compress the development schedule of the Mercury program. First manned ballistic flight may follow a successful MA-3 within a week. A Little Joe flight from Wallops Island was scheduled Apr. 22 in the third attempt to test the production capsule and escape system under maximum dynamic loads.

At the hearings, Atlantic Research Corp. described a new "gel-solid" propellant which the company believes could fuel a multi-million pound thrust vehicle under a schedule which could beat the 1964 Saturn C-1 operational date. Fuel is basically a solid with a specific impulse of 250 sec., but it is mixed in a liquid carrier and gelling agent to form a viscous slurry. The company says the fuel can be delivered to the launch vehicle for 80 cents per pound.

In the NASA testimony, Dr. Seamans said Apollo was cut from an original $71.2 million to $29.5 by both Kennedy and Eisenhower Administrations.

Dr. Seamans strongly recommended restoration of $42.6 million for Apollo, which would permit award of a hardware contract for circumlunar development flights with large-scale spacecraft models. He estimated the flight program could be accelerated 6-12 months with full funding.

First part of the Apollo flight program, deleted from the budget, was instrumentation of the last four Project Mercury production capsules for multiple earth orbits containing primate passengers. They would be capsules 21-24 produced by McDonnell Aircraft Corp.

Congressional testimony also showed that the agency requested Fiscal 1962 funds totaling $1.4 billion, of which the Eisenhower Administration approved $1.1 billion. Kennedy Administration added $125.7 million to the Eisenhower budget.

The original request differs from the current Administration budget by $182.5 million, affecting these programs in addition to Apollo:

- **Rover nuclear rocket** engine program, $15 million deleted for facilities to test the complete Rover engine, and $8.5 million deleted from research and development funds. Lack of facilities will delay the program 6-9 months, if they are not provided until Fiscal 1963, according to Maj. Gen. Don R. Ostrander, NASA launch vehicles director.
- **Personnel addition,** 300 not approved at Space Task Group for Apollo management.
- **High-vacuum propulsion** test facility at Lewis Research Center and a manned satellite tracking station were not approved.

Total Kennedy cuts in NASA requests included $136.8 million in research funds, $32.9 million for construction, and $12.8 million for salaries and expenses.

NASA spokesmen are in an extremely sensitive position. They must justify the Kennedy budget and at the same time explain what is needed to close the growing prestige lead now held by the Soviets in space projects. In most cases, money is the requirement. Committee Chairman Overton Brooks (D.-La.), who predicted a $1.5-billion NASA budget for Fiscal 1962 several months ago, said his committee will go through the cuts, program by program, to determine if the over-all civilian space effort can be accelerated.

NASA's management philosophies came under criticism, particularly from Rep. James Fulton (R.-Pa.), who accused the agency of surrendering to the Budget Bureau without an argument. He suggested that the management teams of Rear Adm. William F. Raborn, who heads the Polaris project, and Vice Adm. Hyman Rickover, head of the Navy's nuclear reactor programs, be transferred to the space agency.

USAF, Army Detail Aircraft Plans

Washington—Air Force and Army disclosed additional details last week on aircraft and missiles planned for purchase during Fiscal 1962.

Army reported to Congress that it has earmarked $211 million for aircraft procurement and $550.8 million for missile procurement, including:

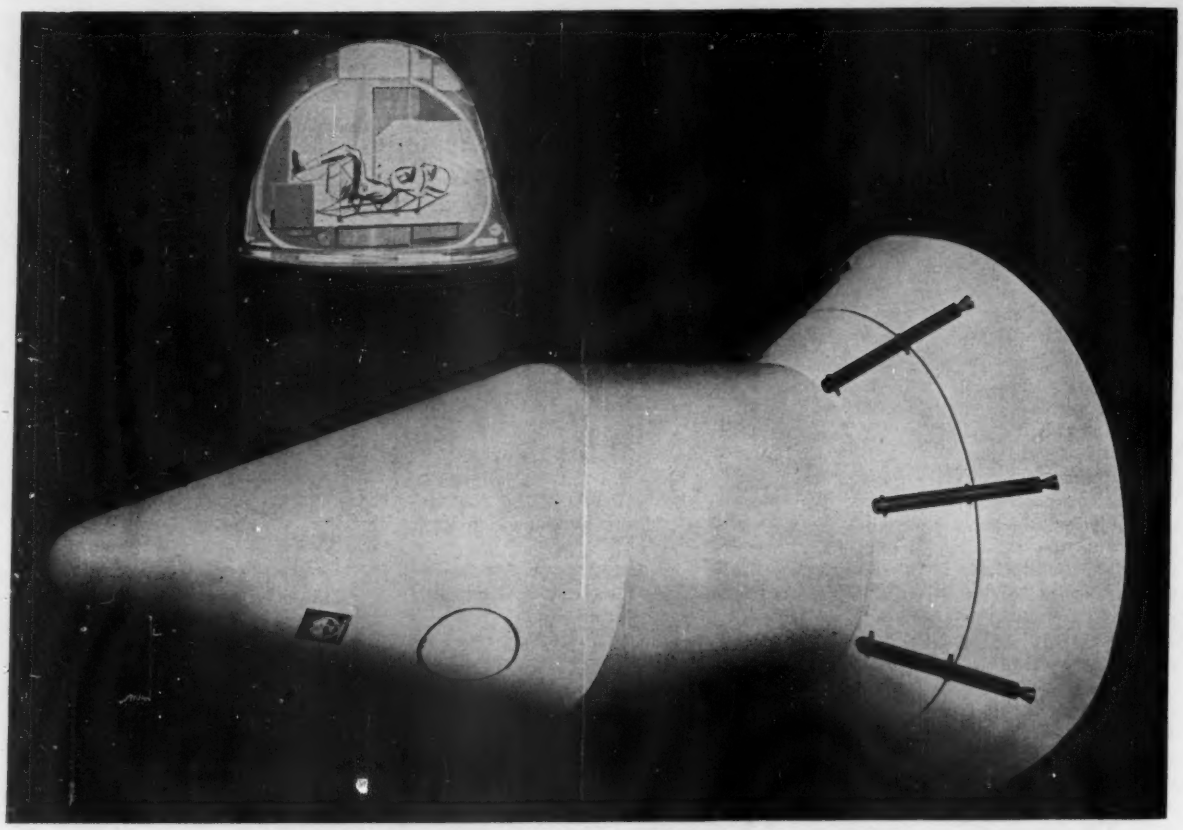
- **Bell Iroquois** helicopter, $67.6 million for 242.
- **Vertol Chinook** transport helicopter, $35.4 million for 24.
- **De Havilland Caribou** STOL transport, $30.2 million for 48.
- **Grumman Mohawk** surveillance airplane, $42.8 million for 48.
- **Beech Seminole** transport, $1.8 million for 14.

In addition, $33.2 million is allocated for spare parts, installation kits, and transportation to initial destination.

The seven missiles in Army's Fiscal 1962 procurement program are Hawk low altitude defense missile, Nike-Hercules air defense missile, Redeye man-transportable air defense missile, Honest John short-range missile, Little John free rocket system, Pershing solid propellant guided missile, and Sergeant solid propellant guided missile.

USAF reported these allocations for Fiscal 1962 purchases:

- **Boeing KC-135** tanker, $185.7 million for 72.
- **Republic F-105** fighter, $369.9 million for 192.
- **Northrop T-38** pilot trainer, $128.9 million for 144.
- **North American T-39;** specialized training aircraft, $50.3 million for 55.
- **Lockheed T-40** support aircraft, $19.1 million for 10.
- **Guided air rockets** (GARs), $41.6 million for three types: Hughes Falcon GAR-3A, GAR-4A, and GAR-11.
- **Martin Bullpup** air-to-surface missile, $26.7 million.
- **Ryan Q-2C drone** for weapon system testing, $10.9 million.



First Photos of GE's Apollo Configuration

First photos of General Electric Missile and Space Vehicle Department's concept of the three-man Project Apollo space vehicle show model used in congressional hearings. Dome-shaped capsule similar to Nerv and Discoverer re-entry bodies is one version of the command module, which would house men in flight and return them to earth. Beneath the conical section of the complete vehicle is another version of the command module. Rockets on flared skirt are for emergency escape during boost phase. GE is one of three companies making paid Apollo feasibility studies for National Aeronautics and Space Administration.

Soviets Will Explore Space Survival Limits

Moscow—Next major goals of Russian space research will include determining the extreme limits of survival of living organisms in order to make prolonged flights to planets as safe as earth orbital flights, Soviet scientists reported last week.

Medical scientist Oleg Gazenko believes on the basis of Maj. Yuri Gagarin's flight around the earth Apr. 12 (AW Apr. 17, p. 26) that it will not be necessary to train man to endure weightlessness except to acquaint him with it.

Prof. Ivan Maisky, director of the Academy of Medical Sciences' Experimental Biology Institute, said the time has now come to make more detailed studies of the effects of space factors on biological substances. Especially important, he said, is the study of the extreme limits of survival of living cells, but effects of prolonged weightlessness on biochemical processes also require more study.

Vladimir Englehardt, described as a leading Soviet biochemist, wrote in Izvestia that the walls of Soviet space ships ensure sufficient radiation protection "at the altitudes now under consideration," but said with penetration into new zones, where radiation is more intense and has greater penetrating force, protective measures will need further perfecting.

Englehardt, director of the Academy of Sciences' Institute of Radiation Physiochemical Biology, said results of spaceflights with living organisms have proven encouraging and have shown the magnitude of possible aggregate radiation effect to be small, lying "far below" the threshold at which unfavorable consequences could be expected.

Andrei Lebedinsky, a member of the Academy of Medical Sciences, told the Soviet news agency Tass that scientists had considered acceleration, weightlessness and radiation to be the three greatest dangers, in that order, before Maj. Gagarin's flight. A recent article in Meditsinsky Rabotnik referred to a 7 or 8g acceleration as the maximum stress on launching for spaceflight. Prof. Vladimir V. Dobronravov indicated that Gagarin's flight resulted in a maximum stress of 5g.

Pilot Error Ruled Out In Downing of B-52

Air Force has decided the accident in which a New Mexico Air National Guard F-100 accidentally shot down a Strategic Air Command B-52 bomber with a Sidewinder missile, was caused by an unknown mechanical malfunction rather than by pilot error.

Findings of a joint USAF-industry investigating board (AW Apr. 17, p. 30) were given late last week to Directorate of Flight and Missile Safety.

Maj. Gen. Perry B. Griffith, deputy inspector general for safety, said that positive steps have been taken to prevent recurrence of this type of incident.

"Most recurring cases of unintentional releases from modern jet fighters of items such as fuel tanks, bombs and pylons are malfunctions of a mechanical nature," he said. "Other causes involve electrical short circuits that cause firing circuits to become energized due to moisture, tiny metallic foreign objects, faulty construction and human loading error. Pilot error is in a singular minority."

Space Pressure Suit Designed by Latex

Washington—International Latex Corp. has developed a full pressure suit designed to meet requirements for both circumlunar and moon surface operations and to permit a crewman to operate outside his craft in the space environment.

The 21-lb. suit is the first garment developed specifically for protection against radiation, temperature and pressure hazards of space, according to Leonard F. Shepard, research and development manager, Latex Government and Industrial Products Division.

Latex developed the suit, in a program which started six years ago under joint Air Force Systems Command-company funding. Cost of the program to date is estimated at $500,000, equally shared by USAF and Latex.

Self-contained environmental system for operation outside the spacecraft is carried in a battery-operated back pack. The company has worked with the Garrett Corp. to develop a system which will use the energy of evaporating liquid oxygen to power the portable environmental pack. Latex also is developing light flight boots with magnetized attachments to replace the 5-lb. standard boots which now are part of the system.

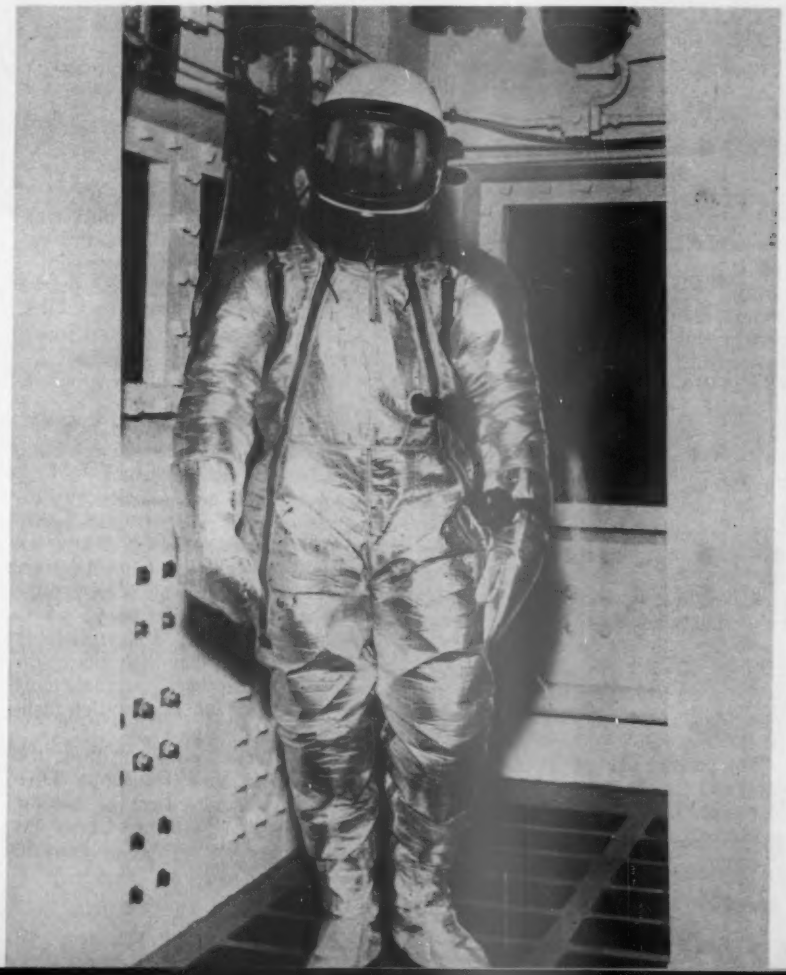
The suit could incorporate self-contained radiation shielding by pumping either water or saturated hydrocarbons through a liner in the outer layer, Shepard said. Pumping system would be activated during passage through the Van Allen radiation belts and during a solar storm.

The suit can be donned by a pilot unassisted in 4-6 min. It has been worn through re-entry temperature profiles reaching 260F loads for 35 min. Cooling is provided through an oxygen pressurization and circulation system which removes carbon dioxide and provides moisture control. Suit temperature can be varied; pressure remains at 5 psi.

Because of its mobility and ease of donning, Shepard said, the suit is an operational piece of equipment rather than an emergency device such as other suits which stiffen when pressurized and make the wearer a "prisoner" in his suit. He sees its potential use in manned probes, circumlunar flight and exploration of the moon's surface, since requirements for these missions have been defined.

Suit consists of pressure retaining and mechanical restraint inner layers made of nylon cloth which have a combined neoprene layer at each joint. The 5-lb. helmet is an epoxy resin shell with a face opening. It is connected to the suit with a rotating ring seal and corrugated neoprene neck section.

FULL PRESSURE space suit developed by International Latex Corp. provides mobility by use of corrugated neoprene joints in the inner nylon cloth layers. Outer layer, also of nylon, has an aluminum vapor deposit. Battery-powered back pack holds a portable environmental system designed to permit a crewman to operate in space outside his craft. Water or saturated hydrocarbons can be pumped into the suit to provide radiation protection. The 21-lb. suit maintains a 5 psi. pressure and can be donned by a pilot in 4-6 min.



Bell Attempting to Consolidate Unions

By William H. Gregory

Bell Aerosystems Co. is attempting to reduce the effective number of unions it deals with at its Buffalo, N. Y., facilities from nine to three as part of a program begun since Textron, Inc., acquired Bell defense companies nine months ago.

The Textron formula for its holding-company type of management of Bell does not include anything radically new to the defense business, but it has produced some specific short- and long-range goals, tight cost and personnel control being one.

Bell's Buffalo area employment has gradually dropped from its 16,000 peak in 1956. Further personnel cuts followed the Textron acquisition and the nadir was reached last summer as Bell's B-52 engine nacelle subassembly contract, which was not profitable, phased out. From a low point then of fewer than 3,000, employment has since risen to about 3,200.

Drop in business appeared to be a factor in gaining union cooperation for some consolidation. One union group has resisted, and a decision is expected by June 1 from the regional National Labor Relations Board, which conducted a hearing in the case last month.

The request by Bell to consolidate the unions is a novel one, and there was no legal precedent to guide the Board. The original union organization at Buffalo, all United Auto Workers (CIO) affiliates, comprises:

- **Local 501** composed of production workers, now with about 900 members.
- **Local 1286** composed of four separate groups of workers: mold loft, production engineering, estimating, and production control. Each group has its own bargaining representatives and shop committees and its own officers. Total membership has been about 1,000.
- **Local 516,** also composed of four separate groups with individual officers and bargaining and shop committees: inspectors, timekeepers, accountants and fire captains.

No change was sought in Local 501. Local 516 agreed voluntarily to the consolidation into one group two months ago, and its 22-man bargaining committee that formerly dealt with management was reduced to seven people and the number of shop committees also was reduced. The other local, 1286, decided not to accept the proposal and thus the hearing. Its bargaining committee of 25 people also would be reduced to seven.

The positive pole of the Textron-Bell program, as described to AVIATION WEEK by George W. Miller, Textron president, is for Bell to establish itself in proprietary design fields to avoid becoming what he described as a glorified job shop.

To this end, Bell is pursuing what would seem to be a contradictory course in seeking major subassembly work on the Lockheed C-141 turbofan cargo transport. The theory is that Bell could use such business to gain time for proprietary development and to reduce its overhead at its Buffalo facilities to make its proposals on Bell-designed products more competitive—its tri-service transport proposal made jointly with Lockheed, for example.

Miller described Bell's long-range goals as not seeking business for the sake of getting business, but to go after business where Bell has experience and capability, can be competitive in cost and where it conceivably could make a contribution to the national effort. Miller listed these areas in importance for Bell's Aerospace Rockets Group, one of two into which the Buffalo operation is divided:

- **Rocket propulsion** for upper stages and space ships. This is based on Bell's Hustler engine now in four-a-month production for the Discoverer, Midas and Samos programs, and would call for development of a family of engines. Bell in this instance would avoid the big booster field, but might eventually go into electrical propulsion on a company-sponsored basis if necessary.
- **VTOL aircraft,** based on Bell's background with the X-14 deflected thrust experimental airplane and its tilting jet experimental work.
- **Reaction controls** for space craft.
- **Structures** for special applications, such as Bell's double wall structure developed for its Dyna-Soar proposal.
- **Target drones,** based on a license with France's Nord Aviation. U. S. Navy is now evaluating a Nord supersonic drone, the CT-41.

The other major Buffalo group is Avionics, and it is stressing:

- **Automatic Landing System** now under contract for installation on some of the Navy's aircraft carriers.
- **Accelerometers and velocity** measuring devices, now used in the Sperry Sergeant and other missiles. These are developed at Bell's Avionics Division Instrument Laboratory in Cleveland.
- **Inertial guidance** systems.

Textron's role has been to clarify Bell's objectives rather than chart new ones, such as has been the case in its establishment of the Textron-Bell management relationship.

Harvey Gaylord, brought from the presidency of Bell's Helicopter Division in Ft. Worth, Tex., to become president of Bell Aerospace Corp., was given a better and clearer assignment, Miller said. Corporate officers other than Gaylord were eliminated, and he reports directly to Miller at Textron. The presidents of each Bell division, Aerosystems at Buffalo, Helicopter, and Hydraulic Research & Mfg. Co., Burbank, Calif., report directly to Gaylord.

Textron, which acquired Bell as part of a preconceived diversification and expansion program (AW Apr. 25, 1960, p. 31), believes primarily in operating with a small Textron corporate staff and giving divisional executives latitude to perform.

Planning for the other two divisions has been more of a long-term nature since they had fewer immediate problems than the Buffalo division. Two major turning points will soon face the Helicopter division, however:

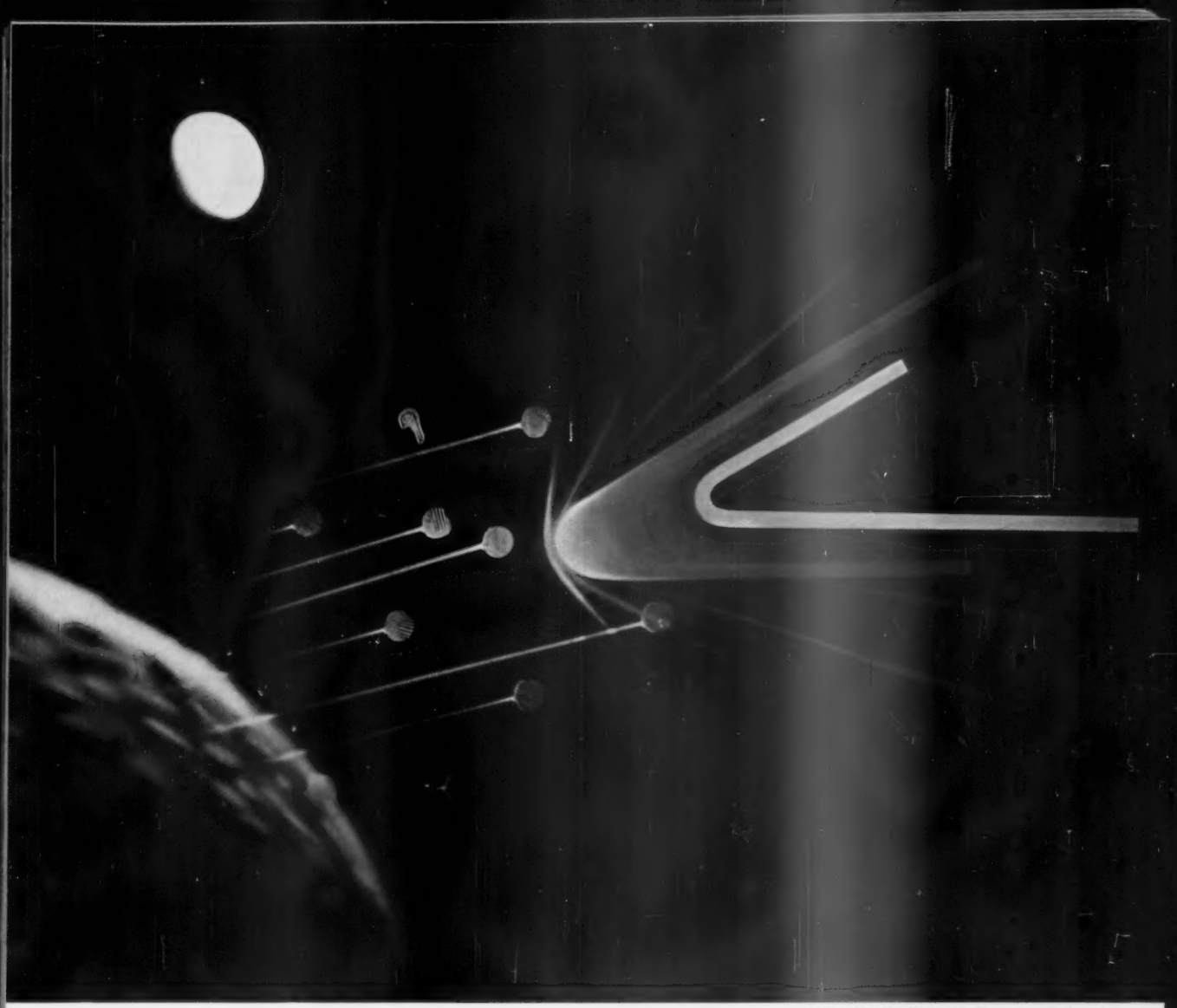
- **Decision on certification** of the Model 240, a commercial version of the Bell HU-1 Iroquois. Miller said there likely will be a place for helicopter buses and helicopter taxicabs at dispersed jet fields, and there may also be a place for helicopter limousines—where the 240 fits. Evaluation of this and the potential executive market will help answer the question of whether to certificate the ship, Miller said.
- **Army decision** in the light observation helicopter (LOH) competition. Any choice that would put a new manufacturer in the light helicopter field would make Bell's position in it very ambiguous, Miller pointed out.

Longer term decisions also face the Helicopter division, Miller added. These range from whether the HU-1 should eventually have its single engine replaced by two small turbine engines to how the VTOL capabilities of the Helicopter and Aerosystems divisions might eventually blend.

Bell has abandoned plans for a research center in the Buffalo area named for the company founder, Lawrence D. Bell, and the land has been put up for sale. Building of such a center might be undertaken eventually, Miller said, but Washington, Southern California or Florida are likely sites.

Textron's biggest assist to Bell, Miller said, is in its ability to wait. The parent company is organized in an effort to avoid cyclical swings of any one industry, and it has the credit and capital to back Bell in any sizable undertaking. Bell has its own line of credit with banks of $16 million, and Textron can supply additional credit.

Fundamentally, Textron's aim is to break the chain in which Bell had the reputation of having "too many firsts and not enough lasts," that is, to gain solid production business from the design originality of the company.



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Double-Wall is only one of the many contributions Bell Aerosystems Company is making to the scientific progress and defensive strength of the free world. We invite qualified engineers and scientists to inquire about sharing our challenging and rewarding future.

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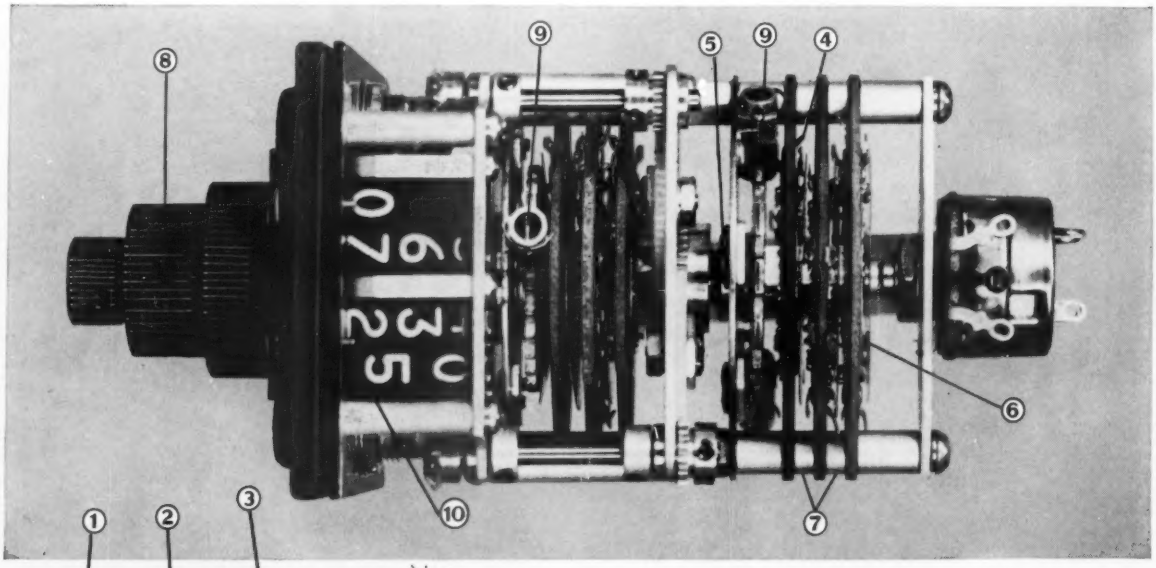

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Kennedy Reviews Decision to Begin Rover Engine Flight Test Program

By Katherine Johnsen

Washington—Kennedy Administration is reconsidering its decision to move forward with a flight test program for the Rover nuclear rocket and is awaiting the outcome of an evaluation by a committee appointed by Presidential Science Adviser Dr. Jerome B. Wiesner and headed by Dr. Harvey Brooks, dean of engineering and applied physics at Harvard University.

This was disclosed in a letter last week from A. P. Luedecke, general manager of the Atomic Energy Commission, to the Joint Congressional Atomic Energy Committee. It touched off a protest on the House floor by Rep. Melvin Price (D.-Ill.), chairman of the research and development subcommittee, that the Administration is losing the opportunity to make a significant jump over Russia in the space field by delaying this project with its potential for interplanetary exploration.

Both the Eisenhower Administration budget, submitted in January, and a revised program by the Kennedy Administration in March, were aimed at initiation of flight testing of a Rover powerplant—Project Nerva—as soon as would be technically feasible.

Rep. Price also disclosed that the Administration has denied AEC and National Aeronautics and Space Administration a total $29 million in Fiscal 1962 funds for Rover related to flight test—including $15 million to initiate work on engine test facilities in Nevada. Unless these cuts are promptly restored, Price said, the present 1966-67 target date for first flight is impossible. The Kennedy Administration's budget provides approximately $3 million for ground test facilities, but not funds for flight test facilities.

Tactics of Delay

Noting that the U. S. has a technological advantage in the nuclear field, Rep. Price charged that the same tactics of review, delay, more review, and more delay that characterized the aircraft nuclear propulsion program are now characterizing the nuclear rocket program. He viewed the Administration's "lip service" and "long-range program statements" on Rover as really "steps to provide for a decent burial."

The White House has refused to release any information on the Rover evaluation committee—such as its membership, when it was appointed, or when it will make its report.

In addition to Brooks, it is understood to include Walter Zinn, vice president, Combustion Engineering, Inc.; Stanislaw Ulam, Los Alamos Scientific Laboratory, also a member of the Air Force Space Study Committee (AW Jan. 23 p. 33); Arthur Biehl, Mainhardt - Biehl Associates, who strongly opposed a fly early aircraft nuclear propulsion program as a former Defense Department technical adviser; Theodore Merkle, Lawrence Radiation Laboratory, a key figure in the Pluto nuclear ramjet program; Al Donovan, Aerospace Corp.; Berndt Matthias, Bell Laboratories; Eugene Wigner, Princeton University professor of physics; and William Graham, Rand Corp.

AVIATION WEEK has learned that there is a divergence of opinion within the committee on Rover's future.

In his letter to the Atomic Energy Committee, Luedecke explained that subsequent to the mid-March decision to continue to aim at early Rover flight, "the Administration decided that further study was required before specifically directing the program toward the flight test objective. The amended budget request that was actually submitted to the Congress, therefore, provided for acceleration of reactor testing, but did not provide for the full program aiming at flight test, pending the conclusions of the current study."

Engine Proposals

Concurrently last week, an NASA source selection board was evaluating contract proposals for the Nerva flight engine submitted by Aerojet-General, American Metal Products Corp., General Electric, Pratt & Whitney, Rocketdyne, Thiokol, and Westinghouse.

The Kennedy budget provides a total $46.5 million for Rover, with $35 million allocated to AEC and $11.5 million to NASA. This is $9 million more than the total proposed by the Eisenhower Administration.

Meanwhile, AEC announced a $19.9-million Fiscal 1962 program of research related to aircraft nuclear propulsion: $14.2 million at Pratt & Whitney; $4.5 million at General Electric; and $1.2 million at Oak Ridge National Laboratory. The President's budget provides $25 million, but $5.1 million will be stretched out into Fiscal 1963.

GE employment on aircraft nuclear propulsion will be reduced from approximately 3,500 to 375. At Pratt & Whitney, it will be reduced from approximately 2,350 to 1,450.

The ANP program—reduced from the $150-million annual level of the past several years—is generally considered a lost cause in Congress.

News Digest

Grumman will increase Gulfstream production from two to three a month in July (AW Apr. 17, p. 23). E. Clinton Towl, company president, told stockholders at the annual meeting total Gulfstream orders now are 72 and there is optimism for foreign sales. First quarter sales for Grumman were about $75 million; earnings $1.6 million.

Dr. Theodore Maiman, who successfully operated the first optical maser (AW July 18, p. 96), has left Hughes Aircraft Co. to join Quantatron, Inc., Santa Monica, as director of applied physics. Other members of the Atomic Physics Group at Hughes Research Laboratories are expected to join Quantatron and other organizations, which will require restaffing of the Hughes group projected to work on a $300,000 Air Force R&D contract for optical masers.

Jet fuel tax was recommended last week by President Kennedy. He asked Congress to tax jet fuels at the 2-cent aviation gasoline rate in Fiscal 1962, then increase the rate on both fuels a half-cent a year until it covers the federal airways costs "properly allocable" to civil aviation. Extension of the transportation tax also was requested.

Air Force Radio Research facility, using a 120-ft. dish antenna and costing $3.8 million, to study satellite communications and space propagation phenomena will be built for operation by Massachusetts Institute of Technology's Lincoln Laboratory at Haystack Hill, Tyngsboro, Mass. North American Columbus Division will build the antenna, and H. I. Thompson Fiber Glass Co. will build the protective dome.

Proposals to study flight dynamics of nuclear third stage on the Saturn C-2 have been submitted to Marshall Space Flight Center by Convair-Astronautics, Douglas Aircraft, Lockheed Missiles and Space Division, Martin and North American Aviation.

British European Airways is negotiating for three Armstrong Whitworth 650 Argosy freighters to expand air cargo activities. Order puts Argosy sales at 66 planes.

First P3V-1 Orion anti-submarine warfare aircraft has been accepted by the Navy from Lockheed Aircraft.

National conference on the peaceful uses of space will be held May 26-27 in Tulsa, Okla., sponsored by the National Aeronautics and Space Administration and the Tulsa Chamber of Commerce.

Kennedy Will Give KLM West Coast Route

Decision is reached without consulting U. S. air carriers; Dutch will have to accept U. S. capacity concepts.

By L. L. Doty

Washington—U.S. decision to grant a West Coast polar route to The Netherlands, reached without consulting U.S. air carriers, has stirred bitter reaction within the airline industry.

Although the route will be granted only if the Dutch agree to a number of conditions involving capacity restrictions, the invitation from the State Department to resume negotiations on the Los Angeles great circle route is viewed by industry as an abrupt departure from accepted policy of trading international routes on a purely economic equal exchange basis.

State Department and The Netherlands still have to negotiate amendments to the bilateral, but a final decision to give the Dutch a West Coast route for KLM already has been reached in the White House (AW Mar. 6, p. 41).

Negotiations are being opened on direct orders from President Kennedy, who issued the instructions following talks with Dutch Foreign Minister Dr. Joseph M. A. Luns at the White House earlier this month. State Department promptly notified The Netherlands of its willingness to reopen negotiations, which collapsed last year when the U.S. flatly refused to grant KLM traffic rights in Los Angeles (AW Oct. 17, p. 38).

Carriers Not Consulted

The offer was made under a tight lid of security, although State previously had assured the airlines that no action would be taken on air transport bilateral agreements without first consulting interested airlines. The carriers learned of the move only after the invitation for negotiations had been sent to the Dutch. In a separate note, scheduled for delivery to Dutch officials late last week, State has laid down the ground rules that would establish the capacity restrictions. These requests include:

- **Dutch agree** to the U. S. interpretation of the capacity clause of the bilateral agreement between the two countries (AW Aug. 1, p. 47). The Dutch, along with most European nations, agree that traffic carried between the U. S. and Holland is subject to the capacity clause of the bilateral. However, the Dutch, again in agreement with other European countries, contend that once such traffic moves beyond Amsterdam, it is solely Dutch Third or Fourth Freedom traffic and is outside the jurisdiction of the U. S. bilateral agreement. U. S. holds that this traffic is "Sixth Freedom traffic," a term coined by the U. S. and defined as being in the same category as Fifth Freedom traffic, making it subject to the bilateral capacity clause.
- **Dutch exchange** traffic statistics as a means of monitoring the volume of traffic carried by each nation.
- **KLM temporarily "freeze"** its scheduled flight frequencies at a specified level, probably at the volume planned for the 1961 summer peak season.

The Sixth Freedom category was created by the U. S. to provide some measure of control over traffic moving between the U. S. and points beyond those named in the bilateral agreement. Fifth Freedom traffic is generally interpreted to be that carried by the flag carrier of one country from a second country to a third on the routes specified in the bilateral agreement.

Sixth Freedom traffic is used by the U.S. to define traffic that is carried by the flag carrier of one country to another country beyond the route specified in the agreement. This traffic, the U. S. claims, is subject to the same restrictions as Fifth Freedom traffic.

Most nations will agree that traffic moving on KLM, for example, from the U.S. through Amsterdam without a stopover at Amsterdam could feasibly be classified as Sixth Freedom traffic, which is categorized as "secondary" traffic. If there is a stopover at Amsterdam, the U. S. holds the traffic is still Sixth Freedom traffic, but foreign carriers maintain that it automatically becomes Third or Fourth Freedom—primary traffic—on the route beyond Amsterdam.

Thus the definition of "stopover" becomes a key element in the discord over capacity interpretations of the two countries. Without a set standard, a 12-hr. stop, for example, could reasonably be defined as either a "connection" or "stopover," depending on the carrier's point of view.

The Dutch will vigorously oppose moves to inject Sixth Freedom principles into the negotiations as a means of controlling traffic capacity. Their stand on this and other issues in the case was outlined in a letter accepting the bid for negotiations scheduled for delivery to State late last week. The U.S. failed to force the Scandinavians to accept the Sixth Freedom philosophy—a principle reason for the breakdown in talks with Scandinavia last year (AW Oct. 10, p. 42).

Dutch Will Agree

The Dutch will also agree to the exchange of traffic statistics provided the figures are kept confidential and they are not used to deter KLM in its development of traffic. They probably will agree to a temporary freeze of the schedule frequency, since KLM plans to hold its West Coast flights over the polar route to a limited operation initially.

In 1960, KLM's share of the transatlantic market, now served by 16 scheduled flag carriers, was 7.6%, compared with 24% for Pan American and 15.9% for TWA. A majority of its passengers are U. S. air travelers. In 1958, for example, KLM carried 53,000

Indian Negotiations

Washington—India and the U. S. will open negotiations here Apr. 24 on a proposed route for Air-India International from India to the West Coast using Boeing 707-420 transports (AW Dec. 26, p. 30).

The four Indian delegates—two government officials and two Air-India executives—will press for a stop at Honolulu, arguing that to bypass Hawaii would make the service impractical economically.

B. R. Patel, Air-India vice chairman and general manager and head of the delegation, told Aviation Week that he expects that the "cold war" between Russia and the West will "tone down," resulting in a sharp increase in India-Moscow air traffic. Air India, which opened a sales office in Dallas last week, also has sales offices in Cleveland, Chicago, Los Angeles and Washington. Offices will be opened in San Francisco and Philadelphia later this spring.

passengers between the U.S. and Europe, 93% of them U.S. air travelers. One U.S. airline reports that only 27% of its transatlantic traffic is primary traffic.

Since the introduction of jet aircraft on the transatlantic route, KLM has experienced a substantial increase in traffic.

During the last three months of 1960, number of eastbound passengers flown increased 58.8% over the same period in 1959. Effect of the jet service on capacity is shown in the 84.5% increase in the number of eastbound seats offered.

Chief concern of U.S. flag carriers is the increasing growth of participation by foreign flag carriers in the so-called secondary European gateway—Amsterdam, Copenhagen, Brussels, Zurich, Madrid—compared with the primary gateways of London, Paris or Rome, for example.

U.S. carriers hold that the reason for growing participation of foreign flag carriers in these secondary markets is the ability of these carriers to capture a high volume of Sixth Freedom traffic which, in turn, permits them to operate more flight schedules to and from the secondary gateways than such markets alone justify.

Traffic Lured

By offering such high frequency schedules, carriers serving secondary markets not only generate more "beyond" traffic, but also lure a disproportionate share of the traffic available at the secondary gateways.

In effect, U.S. foreign flag carriers are using the Sixth Freedom principle as a bargaining tool in The Netherlands' drive for a route to the West Coast.

The U.S. is ready to give KLM traffic rights to Los Angeles if KLM will agree to permitting control over its Sixth Freedom traffic and to applying that control through the exchange of traffic statistics.

U.S. airlines charge that the heavy volume of Fifth or Sixth Freedom traffic carried by KLM is in direct violation of the bilateral agreement between the two countries. They say that the Dutch refused to sign a bilateral agreement for 10 years because of the capacity restrictions inherent in all Bermuda-type agreements, and they agreed to the capacity clause by signing an agreement only after they were granted rights into Houston and into New York from Curacao.

Freeze Schedules

By asking the Dutch to freeze their flight schedules, U.S. airlines add that the U.S., in effect, is telling the Dutch they may have the Los Angeles route only if they put a ceiling on the bilateral violations they are allegedly committing.

Two other factors, however, must be taken into consideration before the issues at stake can be properly evaluated. First, the diversionary effect of West Coast operations by foreign flag carriers on domestic operations is causing increasing concern among the trunklines, particularly those who are operating transcontinental services.

Impact on Trunklines

The importance of the international traffic to the domestic carriers is shown in 1959 surveys which reveal that in that year, 50,000 passengers flying between New York and San Francisco in both directions were on a domestic portion of an international flight. Since this is 17% of the total New York-San Francisco traffic, a substantial diversion to foreign flag carriers would represent a sizable revenue loss to the domestic carriers.

In 1959, 11% of the passengers flying in both directions between Los Angeles and New York were international passengers destined to or returning from a foreign country. That year, domestic airlines serving Los Angeles lost 27,000 potential coast-to-coast travelers to SAS, which flew that number over the pole between Los Angeles and Copenhagen. This represents an approximate loss of $3.4 million in revenues to the trunklines.

The second factor to be reckoned with is the increasing emphasis on foreign policy as it is related to commercial aviation. In recent years, the economic considerations of international air transportation have gradually been subordinated to political considerations.

Resume Negotiations

According to Administration officials, President Kennedy agreed to Holland's request to resume negotiations on the West Coast route primarily because the U.S. virtually was committed to taking such action. In the closing days of his Administration, President Eisenhower agreed to give the route to the Dutch simply to strengthen relations between the U.S. and The Netherlands, and he retracted the offer only after the Treasury Department expressed concern over the effect the new route might have on the movement of gold from the U.S.

Since the majority of foreign nations are placing increasing stress on the political importance of flag carrier operations, the U.S. will undoubtedly be forced to view its commercial air transportation operations from a diplomatic viewpoint and negotiate for traffic rights and routes on the basis of foreign relations rather than on economic principles.

U.S. Capacity Clauses

Washington—Key to capacity control in Bermuda-type agreements is found in these provisions of all bilateral pacts negotiated by the U.S.:

"It is the understanding of both contracting parties that services provided by a designated airline under the present agreement shall retain as their primary objective the provision of capacity adequate to the traffic demands between the country of which such airline is a national and the countries of ultimate destination of the traffic. The right to embark or disembark on such services international traffic destined for and coming from third countries at a point or points on the routes specified in this agreement shall be applied in accordance with the general principles of orderly development to which both contracting parties subscribe and shall be subject to the general principle that capacity should be related:

- "To the traffic requirements between the country of origin and the countries of ultimate destination of the traffic;
- "To the requirements of through airline operation; and
- "To the traffic requirements of the area through which the airline passes after taking account of local and regional services."

United Stewardesses Vote to Join ALPA

United Air Lines' flight attendants selected the Air Line Pilots Assn. last week as their collective bargaining agent to replace the Air Line Stewards and Stewardesses Assn.

There were 1,223 eligible to vote in the National Mediation Board election, and of 1,081 ballots cast, 891 were in favor of joining the pilots' union. Seven ballots were voided, and 178 hostesses voted to continue their association with ALSSA, once an affiliate of ALPA but now linked to the Transport Workers Union.

ALSSA President Rowland Quinn's motion to temporarily enjoin the National Mediation Board from holding such elections was dismissed by a U.S. District Court.

Decision relating to Quinn's plea for a permanent injunction is expected next week.

Last month, Braniff flight attendants voted 214 to eight to be represented by ALPA's newly created Steward and Stewardesses Division.

Similar elections under National Mediation Board auspices are expected at Continental, Capital, Piedmont, West Coast, Mohawk, Pacific Northern, North Central, Ozark, National and Alaska Airlines.

Campaign to Lower Jet Minimums Based on Automatic Flight Systems

By Philip J. Klass

Washington—Pan American World Airways and American Airlines have asked the Federal Aviation Agency to lower turbojet transport minimums from 300 ft. and ¾ mi. to 200 ft. and ½ mi., based on the use of automatic approach couplers and flight directors and a maintenance-pilot training program aimed at assuring reliable operation of the avionics equipment.

The FAA has formed a team to study the airlines' request and the results of an all-out effort by Pan American to debug its autopilot approach couplers and flight directors, tighten up maintenance procedures and expand pilot training in the use of the devices. United, Eastern, American and KLM Royal Dutch Airlines recently have launched similar programs, and other carriers are expected to follow.

Although FAA currently is noncommittal, observers speculate that it may authorize lower jet minimums for specific airports, where ILS and lighting facilities are suitable, and on an individual carrier basis when the airline can demonstrate sufficient equipment reliability and adequate pilot familiarity.

Expensive Diversions

Current airline interest in automatic approach couplers and flight directors, which previously have been viewed only as accessories of convenience by most air carriers, results from the heavy economic penalties incurred when 120-passenger jet transports must divert to distant alternate airports or be grounded because of weather below their minimums.

As jet aircraft, with their higher minimums, have replaced piston-engine aircraft, the industry has, in effect, taken a step backward in what previously had been an unbroken progression toward all-weather reliability.

Airline efforts to put auto-approach couplers and flight directors into operational use are part of a longer-range program aimed at advancing the industry toward the goal of all-weather operations. Approximately a year ago, the Air Transport Assn. formed an All-Weather Operations Committee.

The ATA group is following FAA developments and tests of several new automatic landing systems, but it has concentrated its efforts on more immediate objectives aimed at improvements in existing equipment to make a gradual transition via reduced minimums toward the ultimate goal.

The general view of airline operations people is that if jet transports are to operate down to the same 200 ft., ½ mi. minimums as piston-engine aircraft, more precise and consistent instrument approaches are required because of the limitations on large maneuvers at low altitude imposed by the jet's swept wing design. This, they believe, requires the use of auto-approach couplers, or at least flight directors.

The flight director computes and indicates to the pilot the best flight path for capturing and tracking the ILS localizer and glide slope beams. The approach coupler goes a step further and enables the autopilot to fly an aircraft to automatically capture the ILS beams and follow them down.

Although approach couplers are installed on all jet transports and were installed on some piston-engine aircraft, they have been used by relatively few airline pilots.

Most frequent reason expressed by pilots is that the coupler does not function well, presenting a hazard to safe approaches. There are several possible explanations for this situation—equipment design problems, lack of adequate autopilot-coupler flight time during original aircraft flight tests, inadequate airline maintenance and/or lack of pilot familiarity with coupler use.

The result is a cycle in which lack of pilot use results in an absence of complaints to airline maintenance department and the autopilot manufacturer, so no corrective steps are taken.

Pilots also are reluctant to risk losing their proficiency at making manual instrument approaches, because of possible coupler failure during an approach and because they must make manual instrument approaches in their proficiency tests.

Two years ago, Pan American, spurred by heavy cost of diversions to alternate airports during its first winter of operating jets, launched a program to investigate available automatic landing systems. After studying the British Blind Landing Equipment Unit (B.L.E.U.), and the systems under test by the FAA and the Air Force, Pan American decided that these systems were too far in the future, and immediate gains could be made with existing equipment and facilities.

Last summer, the carrier launched a program to eliminate design difficulties in its autopilots, approach couplers and flight directors, to improve maintenance personnel skills and procedures, and to train its pilots on use of the equipment.

After each 2,500-hr. jet transport overhaul, an autopilot specialist is assigned to accompany the aircraft on its flight test to check operation of the autopilot, approach coupler and flight directors. The semi-annual pilot proficiency test was expanded to include both coupler and flight director ILS approaches down to 100-ft. altitudes.

Approximately four months ago, Pan American felt that its automatic flight control systems were in sufficiently good shape that it could officially encourage its pilots to use them whenever possible, making auto-coupler ("coupled") ILS approaches even during VFR conditions where traffic conditions permitted. Pilots were encouraged to file reports with the operations office indicating how the equipment was operating. Last month, more than 100 such reports were received, most of them "very encouraging," the carrier told AVIATION WEEK. A copy of the report goes to maintenance, which automatically follows up any pilot complaint of unsatisfactory performance.

Equipment Changes

Pan American's program has pointed to the need for design changes and modifications in the basic equipment. For example, the Sperry Zero Reader (flight director) is being modified to use heading-rate to provide better operation under cross-wind conditions. Sperry and Douglas Aircraft have recently completed a flight test evaluation of several improvements for the SP-30 autopilot used on the DC-8. These modifications, which Sperry has started to introduce on Pan American equipment, include the use of more magnetic heading signal to smooth out noise in the localizer beam signal, increased anticipation in the glide slope capture circuits and reduced tightness of pitch-axis control to permit more stable glide slope tracking to lower altitudes.

Pan American will soon run tests on a dual-axis approach coupler configuration in which the pitch axis (glide slope) control will be manual while the heading and roll-axis will be under autopilot control. This mode of operation could provide the tight localizer tracking required for low approaches, but leave the critical pitch axis under pilot control—at least until coupler reliability and pilot confidence in it have been established.

United Air Lines recently has instituted a more rigid procedure of autopilot checkout and maintenance, and has sent teams to various maintenance stations to train personnel on new procedures. Simultaneously, the company is expanding its pilot training in use of autopilots and approach couplers. By June, United expects to have equipment on its DC-8s ready and will then encourage pilots to use approach couplers for instrument approaches in both VFR and IFR weather, a spokesman said.

FAA Influence Seen as McDermott Quits

By David H. Hoffman

Washington—The forced resignation of Francis M. McDermott as executive director of the Air Traffic Control Assn. is being interpreted here as clear indication that Federal Aviation Agency is willing to answer internal criticism with pressure.

McDermott announced his resignation last week after failing narrowly to win a vote of confidence from ATCA's governing body. His supporters believe that high ranking FAA officials were instrumental in securing the negative vote.

McDermott was considered a spokesman for a large controller-pilot group that feels FAA has over-emphasized research projects and under-emphasized current needs of the air traffic control system (AW Feb. 6, p. 39). FAA strongly denies that its fiscal priorities have reflected this approach.

ATCA has had three executive directors in the past five years. The group represents about 80% of FAA's 17,000-man controller force, and initial reaction indicated that most were either "shocked" or "surprised" at McDermott's sudden resignation.

In a letter dated and effective Apr. 15, McDermott maintained that an inadequate staff and an inadequate salary were his reasons for resigning the position he accepted in January, 1960. When asked if FAA had influenced his resignation, he declined comment. He said that he had no immediate plans for the future.

While ATCA looks for a replacement for McDermott, the association is being run by a seven-member executive committee appointed by its council. Edward H. Cockerham, assigned to the operations division of the Bureau of Air Traffic Management, has taken temporary leave of absence to act as ATCA's "administrative spokesman" on matters not directly concerned with FAA. Cockerham is also vice president of ATCA.

The resignation climaxed a meeting of ATCA's 30-member council (board of directors) here. FAA Administrator Najeeb E. Halaby, Deputy Administrator James T. Pyle, and David D. Thomas, director of the FAA Bureau of Air Traffic Management, also attended a portion of the session—from which McDermott was barred.

Although the meeting was called to conduct internal association business, the three top FAA officials apparently came at the invitation of ATCA's four officers, three of whom hold management positions in the FAA's Washington headquarters. Observers sympathetic to ATCA have accused FAA of "promoting" line controllers to staff posts shortly after their election as ATCA council members. A majority of the ATCA council members occupy positions classed as administrative.

During the joint meeting here, Halaby reportedly asked ATCA if it intended to register at least one executive employe as a lobbyist. Halaby also has implied privately that he believes certain questions aimed at FAA officials during recent congressional investigations were "planted" by the controllers' association.

The FAA administrator's remarks have been interpreted to mean that he can see little need for a strong separate association to represent the viewpoint of traffic controllers, especially if that association behaves like a "labor union." Halaby's predecessor, Elwood Quesada, apparently shared this view. FAA spokesmen insisted last week, however, that Halaby's presence at the meeting and McDermott's resignation were "purely coincidental" and that neither Halaby, Pyle nor Thomas played any role in McDermott's decision.

Prime purpose of the joint meeting, Pyle told AVIATION WEEK, was to let the controllers meet Halaby and to let Halaby brief the controllers on how he intends to solve some of their mutual problems. Halaby did strongly suggest, however, that ATCA should act as a professional association and not as a labor group. This comment was not meant to imply criticism of McDermott, Pyle said.

McDermott has frequently contended that FAA should accelerate "Phase One" projects, those that can be implemented with off-the-shelf hardware and short evaluations, in its effort to improve the air traffic control system. During the Civil Aeronautics Board hearings on the cause of New York's Dec. 16 midair collision and during hearings held by the Senate aviation subcommittee, headed by Sen. A. S. Mike Monroney (D.-Okla.), McDermott urged that:

- **New priority be given** the purchasing, testing and installation of "bookkeeping" computers, radar handoff devices, bright radar displays and improved beacon transponder equipment.
- **Bureau of Air Traffic** Management be elevated within FAA and given increased authority to state its operational requirements in terms of "personnel qualifications and standards, engineering support, research direction and general housekeeping."
- **"Unrealistic" Civil Service** Commission criteria that "require" the induction of air traffic controllers who do not possess proper qualifications be modified and that Bureau of Air Traffic Management be taken out from under the over-all agency personnel manager.

Although FAA has generally refrained from commenting on these suggestions and criticisms, it has undertaken a number of new air traffic control projects since the New York collision. Most have won solid support from its controllers. For example, the agency plans to evaluate a TV radar handoff marker system that would ease the problems involved in passing aircraft from Air Route Traffic Control centers to approach controllers and between center sectors (AW Apr. 10, p. 40). FAA also is experimenting with a six-hour work shift for controllers at Washington National Airport. From this trial program, FAA seeks to learn the cost and personnel requirements involved in setting aside two hours of the controller's eight hour day for lunch, briefing and debriefing and refresher training courses.

Task Force Expanded For Project Horizon

Washington—Fred M. Glass, chairman of President Kennedy's Project Horizon task force, has named three additional members to the 90-day study group to bring membership to a total of eight.

New members include Francis T. Fox, City of Los Angeles Department of Airports; Selig Altschul, Aviation Advisory Service; and Jack Loosbrock, editor of Air Force Magazine and Space Digest.

Glass also named an advisory board which will assist the task force in developing its report to the President. Board membership includes William Barclay Harding, Smith Barney & Co.; Edward P. Curtis, Eastman Kodak Co.; Jerome Lederer, Flight Safety Foundation; J. B. Hartranft, Aircraft Owners & Pilots Assn.; William Requarth, General Aviation Council; Clyde P. Barnett, National Assn. of State Aviation Officials; Joseph P. Adams, Assn. of Local Transport Airlines; Coates Lear, Washington attorney; Ronald A. Brown, Flight Engineers' International Assn.; Clarence N. Sayen, Air Line Pilots Assn.; Frank S. Pittenger, American Assn. of Airport Executives; Joseph J. Moraski, Air Traffic Control Assn.; Stuart G. Tipton, Air Transport Assn.; George DeMent, Airport Operators Council; Orval R. Cook, Aerospace Industries Assn.; L. Welch Pogue, Washington attorney; Prof. George Baker, Harvard University; Bruce G. Sundlun, Washington attorney.

Eastern Enters Shuttle Service In Short-Haul Market Competition

Washington—Civil Aeronautics Board encouragement of low-fare commuter service is creating a new area of competition between trunk and local service airlines, testing the theory that lower air fares can build greater traffic volume in short-haul markets.

Eastern Air Lines' planned "air shuttle" service between Boston, New York and Washington will be watched closely by the industry, and several competitive fare plans are expected from other carriers in these heavily traveled, short-haul markets.

Eastern will inaugurate a no-reservation, "come to the airport and go" service Apr. 30 at fares competitive with rail transportation between the three cities. Eight flights a day will be operated with 95-passenger Super Constellations. Departures are scheduled every other hour from 8 a.m. to 10 p.m. Air shuttle fares are an estimated 27% less than first class fares and will be $12 between New York and Boston and $14 between New York and Washington, compared with present railway coach fares of $11.58 and $10.65 respectively.

The shuttle flights will use La Guardia Airport in New York. A passenger can either pick up his ticket in advance, or get a special boarding pass from the airline's ticket counter and pay the fare while on the aircraft.

Eastern will become the third airline to enter the short-haul, commuter field, following a competitive challenge from Allegheny Airlines and an examiner's recommendation in the current New York Short Haul Coach Investigation.

For more than 18 months, Allegheny has been operating a commuter service between Philadelphia and Pittsburgh under an experiment still being analyzed by the CAB. Trans World Airlines fought the $11.81 fare offered by Allegheny, but was forced to adopt it as a competitive measure on the 260-mi. route. Last summer, the Board permitted Allegheny to expand its low fare experiment to the Boston, Providence and Philadelphia market areas, pending a final CAB decision on the airline's Philadelphia-Pittsburgh service. The Board is now waiting for a hearing examiner's decision on this service.

Hoping to expand its commuter service into the New York-Washington market, Allegheny asked the CAB to lift current operating restrictions which force the airline to serve Atlantic City or Philadelphia on all New York-Washington flights. So far, the Board has not acted on Allegheny's request to lift the nonstop restrictions. Examiner Paul N. Pfeiffer rejected Allegheny's bid for a New York-Washington commuter service in the New York short-haul case.

However, Allegheny's request as an intervenor in the case became a key issue which prompted Pfeiffer to concentrate much of his findings on the need for such service in this market. He recommended that if American, National Northeast or Eastern failed to inaugurate commuter-type service on the route within 90 days after a final CAB decision, Allegheny should be given a temporary exemption to perform the service for one year.

Last September, the examiner said, about 41% of Allegheny's fares on the Philadelphia-Pittsburgh route were commuter fares, but since the low tariffs produced a fare savings over first class of $17.89 per round trip and the airline failed to offer sufficient cost data on which to judge the service, Board economists were not adequately prepared to analyze the value of the experiment.

Eastern originally objected to the shuttle concept between New York and Washington on grounds that it would not be economically feasible for a single airline, and that passengers are content to pay more for a confirmed reservation. Later, the carrier asked to be included in any low fare experiment that might be approved for the route.

Justice Criticizes CAB In Nonstop Decision

Washington—Department of Justice was highly critical of the Civil Aeronautics Board last week in objecting to an examiner's decision recommending that American Airlines retain its nonstop authority in the reopened New York-San Francisco Nonstop Case.

Urging the Board to reject the recommendation of Examiner Edward T. Stodola, who is rehearing the case as a result of a U. S. Court of Appeals order last September, the Justice Department took issue with Stodola's support of earlier Board findings that ex parte communications submitted by San Francisco officials and by congressmen in support of American were not important enough to justify rejection of the airline's nonstop request.

Noting that "activities of this type tend to negate, at least, the appearance of fairness in CAB proceedings," the Department of Justice said the entire case has "focused attention upon the unfortunate manner in which these important route cases have all too frequently been handled.

"The trouble is, of course," the department said, "that there is no real way to determine whether these actions calculated to bring editorial and congressional pressure on the agency may not have had an unconscious effect on the Board's decisions."

Cuban Revolt Halts U.S. Airline Flights

Washington—U. S. airlines canceled all remaining service into Havana, Cuba, early last week as rebel forces invaded the island to launch a revolution against the government of Premier Fidel Castro.

Pan American World Airways dropped its two daily round trips between Miami and Havana, and Delta Air Lines canceled a weekly round trip between New Orleans, Havana, Jamaica, and Caracas. Braniff Airways earlier canceled its remaining weekly flight to Havana, and National Airlines dropped all scheduled service to Cuba six weeks ago.

Delta flight frequencies into Havana were as high as 31 trips a week two years ago and were reduced to only three a week last February, the airline said. Pan American provided a daily service pattern of four flights to Cuba less than a year ago, and National offered 12 flights a week to Havana from New York, Tampa and Miami a year ago.

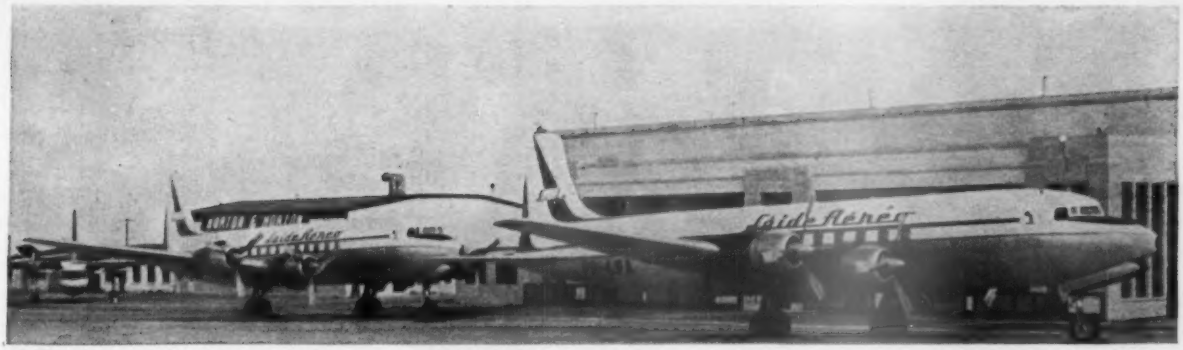
Noise Council Begins Educational Program

Washington—National Aircraft Noise Abatement Council has launched an extensive community education program highlighting the aviation industry's efforts to alleviate noise annoyance.

Main tool for the program is a "do-it yourself" manual now being distributed to all airlines and airport directors plus civic groups in specific noise problem areas.

Emphasizing the importance of using the manual as a yardstick for progress on aircraft noise problems, NANAC's presentation offers a series of sample press releases, sample radio-television interview scripts, airline employe booklets on the sound problem and a 30-page script with 64 film slides illustrating progress and problems in the field of noise abatement.

Reviewing past progress on noise abatement, NANAC calls attention to close cooperation that exists between the Federal Aviation Agency, aircraft manufacturers and airlines to minimize the adverse effects of aircraft noise on a community.



LOIDE AEREO DC-6As being converted to 64-seat all-first-class configuration, are scheduled to enter domestic Brazilian runs in mid-May.

Brazilian Carrier Plans Modernization

Ft. Worth, Tex.—Loide Aereo Nacional S. A. is in the initial phase of an equipment modernization program during which the privately owned domestic Brazilian airline will join the growing ranks of jet transport operators.

Loide's plans, which should significantly influence competitive aspects of Brazilian airline operations, basically comprises three steps at present:

- **Modification of a four-plane** DC-6A fleet to plush all-first-class 64-seat configuration, now under way at Horton & Horton and Inter-American Modification Center, here at Meacham Field, with introduction of the customized transports into domestic Brazilian service planned for mid-May.
- **Modification of its eight DC-4** 64-seat all-tourist accommodation fleet, retaining the lower fare layout but offering the carrier added promotion advantages by sprucing up interiors.
- **Purchase of three jets,** probably Boeing 720Bs or 727s, which Loide representatives have discussed with the manufacturer.

The latter program represents a major switch in the carrier's previous thinking. Initially it had planned to buy Lockheed Electra turboprops. However, sensational treatment in the local Brazilian press concerning Electra crashes, climaxed by publicity at the time of the Eastern Air Lines' accident in Boston last Oct. 14, was a negative factor difficult to erase from the public's mind, management felt.

Indications are that Loide, which started operations 12 years ago with a surplus C-46, also has its sights set on expanding into an international operation, contemplating service to Houston and Los Angeles.

Currently it has been serving 24 Brazilian cities with its fleet of eight DC-4s and eight C-46s, the latter providing entry into the back areas of the country, hauling workers, equipment and supplies into areas where there is no other means of transportation or which are of such difficult access that bush-type air service is the only practical means of transportation.

It plans to add the four DC-6As to the routes served by the DC-4, which has been faced with increasing competition from more modern equipment, including turboprop airplanes. It hopes, by providing an extremely plush service with the DC-6A, that it can offset some of the competition of the higher performance aircraft and larger fleets of its competitors until it gets jets.

The DC-6As are the last four of these cargo airplanes to roll off the Douglas assembly lines—Loide had purchased them approximately two years ago with hopes then of getting permission to start service to the United States. When this did not materialize, it leased the airplanes, until recently, to Panair do Brasil, which had them configured to a 54-seat mixed tourist-first-class fleet. Airplanes are advanced DC-6A models with P&W R2800-CB-17 engines with water injection, fitted with propeller spinners, which are said to provide an additional five knots cruise speed.

Interior Feature

A prime feature of the new interior is the lounge aft of the passenger door. Basically, this is a plush four-seat layout, with seats anchored to a special tubular structure that permits them to be occupied during takeoff and landing. This area can be completely screened off if occupied by a single group of executives, providing them with privacy and permitting in-flight conferences without distraction. If additional group space is required, rear four passenger seats can be quickly reversed, doubling the capacity of this "private conference room." A desktop is built into the side of one of the magazine racks for use by a secretary. A center folding-leaf table is installed that can double as a conference table.

Area is so designed that if it is necessary to utilize the rear of the cabin for freight, furnishings and headliner can be removed and the cargo portion of the DC-6A's rear door can be readily activated.

Remainder of the cabin is fitted with DC-7-type seats having extra wide backs and removable arm rests. Aisle legs on the seats were moved inward some eight inches to provide stewardesses with additional foot room.

Additional cabin roominess is obtained by building new overhead hat and pillow racks that are narrower and lighter by some two-thirds than the previous standard rack.

By completely rearranging galley and restroom areas, Horton & Horton was able to increase first-class seats by 10 over former mixed-fare layout. New twin galleys, designed and built by the conversion firm, are forward of the passenger compartment, completely separated by a door.

There are separate restrooms for men and women.

Cockpit also is being remodeled, utilizing dual Collins communications equipment. Airplanes have Bendix RDR-B-2 weather radar with dual scopes. Loide is planning to install the same type of radar on its DC-4s, but with a single, bright-display scope.

National Orders Seven DC-8s With Turbofans

National Airlines has ordered seven turbofan-powered Douglas DC-8s to meet the added fleet requirements of National's new southern transcontinental route (AW Apr. 3, p. 50).

Delivery of the aircraft is scheduled to begin next October. Service on the route will be inaugurated June 11 under present plans, with initial service provided by National's present DC-8s and Lockheed Electra turboprops. All cargo service will be flown on the route with Lockheed 1049 H freighters.

The turbofan DC-8s will be powered by Pratt & Whitney JT3D-1 engines.

MUROC TEST RANGE OCTOBER 1, 1942

Yesterday . . . Robert Stanley, chief pilot for the Bell Aircraft Corp., snapped on his crash helmet, received last minute instructions, then taxied into take-off position at Muroc Dry Lake. A few seconds later he piloted America's first jet plane, the Bell XP-59A in successful test manuevers. Standard's jet fuel was aboard!

This historic flight is one of many aviation firsts that relied on Standard products — ever since 1917 when Standard developed the first successful aviation gasoline in the U. S.

Today . . . famous Chevron Aviation fuels and RPM Aviation lubricants fly the jet routes... give safe, dependable performance for commercial, business and private pilots everywhere.

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Icelandic Pegs Future on Piston Planes

By Glenn Garrison

New York—Although Icelandic Airlines has become an anachronism on the competitive North Atlantic jet routes, the airline expects to continue flying piston planes—and making money—for some time to come.

The Icelandic carrier this summer will be the only transatlantic scheduled passenger airline not operating jets. Nevertheless, it expects to carry 45,000 transatlantic passengers this year in its fleet of three Douglas DC-6B piston aircraft. This total would represent a 10% increase over last year's traffic on the route.

Icelandic's weapon against the jets and high-powered advertising campaigns of its competitors: fares. The airline has never joined International Air Transport Assn. and considerably undercuts even the economy and special off-season and excursion jet fares of the IATA carriers.

Icelandic Fares

For example, the on-season Icelandic fare to London, round trip, is $416.60, or $69.40 under the IATA economy jet fare on the same route. The IATA propeller fare is much closer: $432 in economy class. But many transatlantic airlines this summer will be offering jet service exclusively on their regular schedules.

Icelandic this year also has instituted 17-day excursion fares for the off season, and a reduced fare family plan, both moves to match similar plans of the IATA carriers, and both well under the IATA jet fares.

Icelandic Airlines' revenues are modest in comparison with some of the transatlantic giants, but on the other hand it operates in the black and receives no subsidy, being entirely privately owned by stockholders.

In its Fiscal 1959 year, Icelandic earned gross revenues of something over $6 million and realized a net profit of about $200,000. Fiscal 1960 profit was about 7% higher. Traffic increase from 1959 to 1960 was double that percentage, but fare reductions held down the increase in revenues.

Icelandic's summer load factor last year was over 80%, and system load factor for the year was 65%. Breakeven load factor in its DC-6Bs is said by Icelandic to be under 50%. This year's off season loads have been increasing, according to the airline, and higher load factors for the year are expected.

Officials of Icelandic say the airline has no interest in buying jets or even turboprops for the time being. It may buy a fourth DC-6B later this year from Pan American—source of the other three airplanes. Icelandic has been on the Atlantic since 1952, operating DC-4s until recently. Last year's fleet was mixed DC-4s and DC-6Bs, but the four DC-4s now have all been sold to various European non-scheduled airlines.

Any future expansion will be gradual—Icelandic doesn't want to grow too fast but to build its organization on a "solid and conservative basis," officials say.

Its growth will be related to the opening up of Iceland as a tourist attraction as well as to the growth of transatlantic traffic per se. Iceland, the airline's officials say, has become the third-ranking terminal for Icelandic Airlines in terms of traffic volume from the United States and considerable future development is foreseen.

Low cost operation—including equipment and overhead—is a key to Icelandic's policy. It strives to keep its ground organization small, and claims that its proportion of ground to flight personnel is 65% of that of other airlines. No outside salesmen are employed: some 90% of its bookings come through travel agents, to which its efforts are chiefly directed. In 1960, Icelandic paid U. S. travel agents more than $400,000.

The DC-6Bs last year achieved a utilization of 3,500-3,600 hr., which averages to something over 9 hr. daily. This year, the average is running better than 10 hr. daily. Operating costs, the airline says, run about 20% below the U. S. domestic average for the same plane—principally because of the low overhead operation.

Route Pattern

The airline also benefits from a favorable route pattern: exclusively long haul, with multiple terminals in Europe (Amsterdam, Copenhagen, Glasgow, Gothenburg, Hamburg, Helsinki, London, Luxembourg, Oslo, and Stavanger in addition to, of course, Reykjavik, its home base in Iceland.)

Passengers on Icelandic's planes enjoy certain advantages and are exposed to certain disadvantages. Service is closer to the former IATA tourist class than to economy: seat pitch in the five-abreast configuration is 38 in., providing more leg room than the economy passengers get. Complete meals and free drinks are served. A free meal on the ground is provided at the Reykjavik stopover, which is scheduled at 1½ hr.

Of course, the trip takes a relatively long time. Flying time is scheduled at 14 to 18 hr. to Europe, depending on

Sabena Operates Caravelle 6

Sud Aviation's Mark 6 twin-jet Caravelle has been in service with Sabena Belgian World Airways since last month. This longer-range version of the French aircraft is powered by Rolls-Royce Avon Mark 531 turbojets. Sabena's configuration is 65 tourist, 12 first class. The airline has ordered six of the planes, received three.

the terminal. And some of the flights involve stops before final destination. However, the airline says that every extra hour on an Icelandic aircraft means a saving to the passenger of $22. The airline's philosophy, its officials say, is predicated on the belief that speed isn't the only ingredient a transatlantic airline has to sell.

Icelandic isn't too worried about the possibility that IATA carriers will go to a very low fare to cut into a new layer of the transatlantic travel market. For one thing, the other carriers are thoroughly committed to jets, are going to have to fill them and pay for them, and aren't likely to go back to cut-rate piston services. Icelandic's tightly-knit organization and low cost operation, its officials say, should make it possible to undercut whatever fare reductions the IATA carriers come up with, and still make money.

At the other end of the scale, low-cost group charter operators would seem to be a threat to Icelandic. This kind of group business has been growing greatly during the past few years, and the round-trip transatlantic fare for a member of a group is under $300 in many cases.

But Icelandic officials say the convenience and flexibility of scheduled travel makes up to a great extent for the difference in fare of the charter passenger. Another consideration, of course, is the fact that a charter group is supposed to meet certain restrictions including bona fide membership in a legitimate group for six months. Anyway, Icelandic considers the market different and says it is not greatly troubled about this competition.

To foster the growth of European tourist traffic to the U.S.—an end attracting considerable interest in the travel field lately—Icelandic plans to recommend to Civil Aeronautics Board and the Department of Commerce that tourists holding foreign passports be granted special fares on U.S. domestic airlines at off-peak times. These fares would be 60% of published tariffs.

Icelandic operates no domestic routes, but the other Icelandic carrier, Icelandair, operates not only domestically but in competition with Icelandic over some routes between Iceland and Europe. Icelandair uses Vickers Viscount turboprops and Douglas DC-4s on these flights.

Icelandic Airlines plans to offer eight weekly round trips between New York and Europe this summer with its DC-6Bs, one more round trip than was scheduled last summer. The aircraft carry 80 seats in rows of two and three abreast.

Maintenance is performed by a Norwegian airline at Stavanger, but Icelandic plans gradually to shift the maintenance operation to its home base at Reykjavik, and to do the work itself.

Pilots of Icelandic's aircraft are U.S.-trained, and U.S. pilots provide check services periodically. Crew numbers seven, including three stewardesses.

Greater Use of Examiners Urged To Reduce Regulatory Backlog

Washington—Senate Judiciary Committee last week urged an increase in the power, prestige and compensation of hearing examiners as the best way to reduce the mounting backlog of business at Civil Aeronautics Board and other regulatory agencies.

This followed a recommendation in the President's message to Congress on regulatory agencies (AW Apr. 17, p. 41) which favored upgrading the competence of hearing examiners through higher pay and better selection criteria.

The committee, headed by Sen. John Carroll (D.-Colo.), commented in a report by its subcommittee on administrative practices that "the readiest instrument available for a concerted effort to eliminate backlogs and delays in the administrative process is the utilization of the existing hearing examiner corps by increased delegations of authority, increased finality of their decisions, and increased authority to control the course of hearings."

The report called for legislation "which will not only permit, but require, the full utilization of the potential of the hearing examiner corps." It observed that "agency control of policy can best be achieved by relieving the principal officers of the decisional duty, thereby freeing them to consider and formulate statements of principles of general policy. . . ." One specific suggestion was to give examiners considerable authority to limit oral evidence and keep records short.

Other recommendations included the following:

• **Increase in the membership** term for all regulatory agencies to ten years. CAB members now serve six-year terms. If a new President were confronted with a majority of three Board members of the opposite political party, the committee said, he should be permitted to replace the one whose term is nearest to completion. But the replaced member would receive his full salary for the remainder of his ten-year term. The committee recommended an increase in the retirement benefits and salary of Board members, as well as hearing examiners, but did not specify how much.

• **Enforcement of ethical** standards. One proposed bill would reinforce the President's authority to establish ethical standards for government officials and apply sanctions—such as removal from office. The problem is so varied, the committee said, that an attempt by Congress to enact details would be time-consuming and unsatisfactory. The second legislative proposal would establish civil and criminal sanctions for participants—government employes or private representatives—in ex parte or backdoor approaches concerning pending cases.

• **Establishment** of an "Office of Administration and Reorganization" in the White House to oversee management of the regulatory agencies. A similar recommendation by James M. Landis, special assistant to the President, provoked considerable controversy and was not included in the President's message to Congress (AW Jan. 2, p. 28).

Mexicana Traffic

(Domestic and International)

	1960	Per cent change over 1959
Revenue miles	12,029,956	— 7.43
Revenue hours	61,124	—13.74
Revenue passengers	564,919	+ 4.23
Revenue passenger miles	381,497,143	+ 7.38
Available seat miles	630,776,416	+ 8.78
Passenger load factors	60.48%	— 1.28
Cargo ton-miles	9,659,543	— 1.43
Mail (tons)	829,936	+ 2.17
Available ton-miles	79,059,183	+ 6.82
Over-all cargo load factors	54.86%	— 2.00

MEXICANA AIRLINES revenue miles on domestic and international routes totaled 12,029,956 in 1960, a decline of 7.43% from 1959. Mexicana operates three de Havilland Comet 4Cs and will take delivery of a fourth this summer. It also operates eight Douglas DC-6s, seven DC-4s, 16 DC-3s and three Fairchild C-82s. It is expected to shortly place an order for U. S.-built jets (AW Apr. 17, p. 43).

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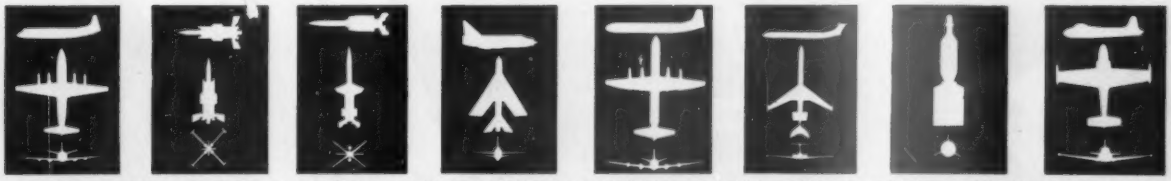

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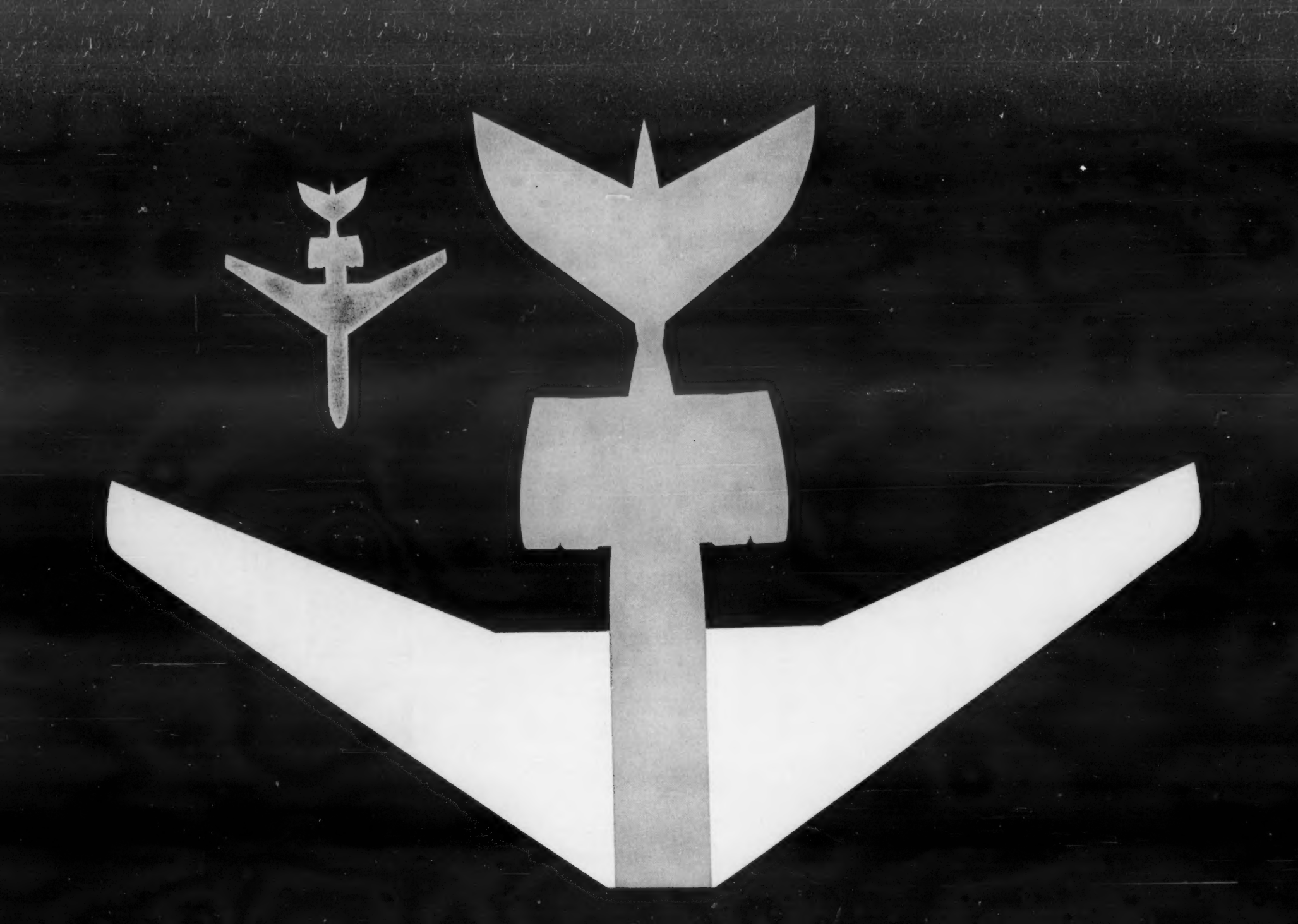

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- The Royal Air Force's all-through jet trainer—Provost.

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- The project study for a Supersonic Airliner.
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- The first all-steel research plane to pioneer the frontiers of supersonic knowledge (T-188).
- Many new weapon concepts which are still highly classified, including Blue Water, the support tactical surface-to-surface weapon for the British Army.

The four member companies of British Aircraft Corporation have, since World War II, built over 5,000 aircraft of all types. This number includes: 500 four-engined Turbine Airliners, 900 Twin- and Four-engined Jet Bombers, 1,700 Jet Fighters, and 1,100 Trainers.

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Airline Income and Expenses—4th Quarter, 1960

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Property*	Charter	Federal Subsidy	Total Operating Revenues	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	93,058,621	2,276,269	8,683,197	741,825	.....	105,166,402	97,445,915	−7,060,205
Braniff	17,098,035	533,119	917,004	304,049	.....	18,956,341	18,096,765	625,491
Capital	23,215,618	595,215	1,040,798	64,094	.....	25,102,259	26,053,215	−1,939,311
Continental	14,032,587	284,409	633,078	85,863	.....	15,279,212	13,844,907	579,696
Delta	31,291,017	670,539	1,732,245	136,109	.....	33,986,324	31,420,678	2,229,328
Eastern	59,786,808	1,616,893	3,311,636	11,711	.....	64,736,490	66,055,142	−669,906
National	13,347,178	352,443	973,836	532,360	.....	15,359,762	17,751,368	−1,965,633
Northeast	8,205,883	155,146	388,927	25,279	.....	8,859,168	12,508,065	−4,296,852
Northwest	16,267,132	649,808	1,575,454	299,092	.....	19,373,331	20,199,346	−1,020,104
Trans World	59,177,239	1,602,722	4,224,511	443,876	.....	66,310,174	65,836,924	361,850
United	82,110,583	3,762,691	6,482,704	713,266	.....	94,898,965	94,214,486	−88,033
Western	13,856,322	350,223	578,544	153,215	.....	15,045,898	14,254,497	591,173
INTERNATIONAL								
American	1,142,878	14,065	227,680	.....	.....	1,448,457	2,163,432	−713,718
Braniff	2,376,878	81,735	39,507	.....	.....	2,806,569	3,125,820	−364,264
Caribbean Atlantic	720,189	10,816	42,263	4,409	.....	789,445	819,606	−28,123
Delta	484,868	3,427	66,124	.....	.....	557,615	878,419	−342,565
Eastern	6,943,690	175,167	430,022	3,056	.....	8,925,479	8,115,534	−649,429
Mackey	295,259	.....	13,823	59,428	.....	371,870	459,465	−76,991
National	407,973	1,474	51,035	6,672	.....	468,987	447,053	21,934
Northwest	3,409,043	1,979,801	979,400	66,711	.....	7,482,691	7,121,649	222,581
Pan American Combined	70,581,783	8,609,246	13,357,834	5,234,092	.....	100,135,244	97,316,930	−356,217
Alaska	878,410	59,744	139,458	.....	.....	1,101,298	1,425,039	−319,548
Atlantic	32,549,995	3,857,686	5,185,228	766,553	.....	43,548,550	43,647,320	50,253
Latin America	16,445,607	714,056	4,307,444	770,387	.....	23,348,481	27,763,104	−4,337,500
Pacific	20,707,771	3,977,760	3,725,704	3,697,152	.....	32,136,915	24,489,686	7,778,123
Panagra	4,045,438	194,609	185,560	7,821	.....	5,581,442	5,611,913	−142,321
Resort	.....	.....	.....	.....	.....	25,914	66,413	−31,162
Trans Caribbean	549,462	.....	66,088	22,375	.....	668,733	634,970	33,793
Trans World	13,929,635	2,638,732	1,990,925	1,907,014	.....	21,617,353	20,102,432	1,219,620
United	4,872,833	274,781	132,105	.....	.....	5,354,619	4,379,508	857,471
Western	1,153,097	11,227	34,558	.....	.....	1,212,896	1,228,471	−35,355
LOCAL SERVICE								
Allegheny[1]	.....	.....	.....	.....	.....	.....	.....	.....
Bonanza	1,194,599	8,982	39,273	12,058	843,546	2,112,338	1,965,838	98,634
Central	603,082	22,950	39,940	31,166	774,414	1,479,555	1,396,827	81,603
Frontier	1,611,602	53,308	113,221	20,193	1,558,761	3,390,518	3,212,935	107,706
Lake Central	707,830	18,847	36,388	4,695	435,957	1,206,255	1,191,233	16,262
Mohawk	2,613,699	45,302	86,897	110,372	1,498,658	4,406,995	3,923,568	338,595
North Central	3,059,790	102,628	184,596	29,967	1,550,621	4,943,378	5,528,939	−641,111
Ozark	1,980,601	46,400	123,291	40,670	830,728	3,041,617	2,978,814	23,384
Pacific	1,379,925	40,647	37,027	169,836	1,397,502	3,037,355	2,860,519	204,357
Piedmont	1,824,335	35,384	76,664	76,253	1,055,563	3,135,053	2,956,492	112,487
Southern	1,218,480	50,573	64,960	3,328	961,984	2,307,266	2,331,940	−26,426
Trans-Texas	1,290,801	45,505	84,871	35,067	1,249,298	2,720,273	2,188,015	618,186
West Coast	1,502,757	32,101	48,135	5,499	1,362,718	2,962,555	2,466,146	436,655
HAWAIIAN LINES								
Aloha	1,064,410	8,215	24,174	1,798	.....	1,133,305	1,389,459	−333,880
Hawaiian[1]	.....	.....	.....	.....	.....	.....	.....	.....
CARGO LINES								
AAXICO	.....	.....	.....	2,877	.....	138,599	127,632	56,661
Aerovias Sud Americana[1]	.....	.....	.....	.....	.....	.....	.....	.....
Flying Tiger	.....	28,932	3,109,865	4,859,461	.....	8,014,065	7,105,573	816,387
Riddle	.....	26,121	1,110,768	823,090	.....	1,984,799	2,349,256	−394,120
Seaboard & Western[1]	.....	.....	.....	.....	.....	.....	.....	.....
Slick	.....	.....	.....	1,926,968	.....	1,887,818	1,729,765	−285,621
HELICOPTER LINES								
Chicago Helicopter	422,500	8,273	2,575	.....	395,039	828,719	900,398	−74,498
Los Angeles Airways	45,099	38,379	39,544	1,129	273,009	398,098	358,924	41,473
New York Airways	259,137	12,190	23,842	18,314	581,487	899,440	962,485	−69,574
ALASKA LINES								
Alaska Airlines	593,393	184,749	208,788	824,344	483,922	2,321,928	2,240,696	60,064
Alaska Coastal	193,410	34,467	35,963	11,759	279,252	562,018	489,412	65,884
Cordova	44,532	35,971	42,335	58,290	120,626	306,660	277,238	25,581
Ellis	124,448	14,102	17,438	2,864	116,562	289,636	307,916	−24,652
Kodiak[1]	.....	.....	.....	.....	.....	.....	.....	.....
Northern Consolidated[1]	.....	.....	.....	.....	.....	.....	.....	.....
Pacific Northern	1,647,283	303,275	384,196	6,433	475,711	2,854,276	2,548,809	275,751
Reeve Aleutian	348,886	147,777	127,530	32,268	.....	664,942	674,920	−19,470
Western Alaska	12,193	5,362	2,687	4,268	20,519	45,602	62,231	−17,971
Wein Alaska	161,902	171,097	87,861	62,871	436,391	940,248	1,067,285	−156,180
Avalon Air Transport	35,216	3,563	1,782	17,950	.....	58,559	122,052	−64,163
Samoan[1]	.....	.....	.....	.....	.....	.....	.....	.....

[1] Not available. * Property figure includes express, freight & excess baggage.

Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.

AIRLINE OBSERVER

▶Air Force is trying hard to interest Federal Aviation Agency in using SAGE air defense centers for air traffic control instead of the system FAA is developing for this specific purpose. With the threat of manned aircraft attack shifting to a secondary position, USAF is anxious to get FAA to share the cost of operating and maintaining SAGE. FAA now has a consulting firm making an economic study of the costs involved, and FAA Administrator Najeeb Halaby recently visited Maj. Gen. Kenneth Bergquist, commander of USAF's Electronic Systems Division, for SAGE discussions. Facilities for experimental use of SAGE for high-altitude traffic control in the Boston-New York sectors, known as Project Satin, are now partially operational and will be expanded to include automatic conflict prediction by the end of the year.

▶Watch for a Civil Aeronautics Board ruling that Riddle Airlines' two petitions--to merge with Aerovias Sud Americana and to receive subsidy--are mutually exclusive. The Board apparently believes the merger with Aerovias would increase rather than decrease Riddle's need for government support.

▶Federal Aviation Agency report on its tests of best methods for making aircraft more conspicuous to avoid collisions will show that the amount of aircraft surface covered with fluorescent paint is more significant than the pattern of the painted surfaces. The FAA report is expected to be released soon.

▶Pan American World Airways, which pioneered airline use of tropo-scatter communications for extending VHF radio communications beyond normal line-of-sight range, is constructing the first airline tropo-scatter station in the Middle East at Beirut. The station will go on the air for initial tests in two months.

▶El Al Israel Airlines is experiencing unusually high load factors on its U. S.-Tel Aviv route. Chief attraction, in addition to Passover season and independence celebrations, is the Eichmann trial.

▶New York Airways will add a cabin attendant to crews on all Vertol 107 flights, which are scheduled to begin this summer. Under Federal Aviation Agency regulations, cabin attendants are required on all aircraft carrying 20 or more passengers. The airline probably will use stewardesses rather than stewards for the job.

▶Friction between British European Airways and United Kingdom independent carriers is increasing. BEA has refused to discuss future relationships with British United, which, with Cunard Eagle, has applied for operating authority on as many as 40 routes, many of which are now served by BEA and British Overseas Airways Corp.

▶Aerolineas El Salvador has been recommended for a foreign air carrier permit on an El Salvador-Miami route by CAB Examiner Francis W. Brown. The carrier proposes to operate the route with one Curtiss C-46A, carrying cargo and mail.

▶American Airlines will perform maintenance and overhaul work at its Tulsa, Okla. base on the Lockheed Electra, Boeing 720 and Convair 880 which are operated by the Federal Aviation Agency to train air carrier inspectors.

▶Aeroflot has more than doubled passenger capacity on its Moscow-Peking route. Seventy-passenger Tu-104As have been replaced by 100-passenger Tu-104Bs, and round trips have been increased from two to three weekly. Other Aeroflot improvements, effective this month, include replacement of twin-engine, piston-powered Il-14s with Il-18 turboprop transports on the Leningrad-Helsinki route. Increased flight frequencies also have been announced from Moscow to Budapest, Paris, London, Cairo, Warsaw, Copenhagen, Amsterdam and Helsinki.

SHORTLINES

▶**Braniff Airways** has exercised its option to purchase a fourth Boeing 720-027. Purchase is being financed with company funds, with neither long-term debt nor equity used. Braniff currently has two 720-027s and is to take delivery on its third in August.

▶**British Overseas Airways Corp.** will operate 138 North Atlantic flights weekly during the June-September period. Total of 17,000 seats will be offered each week on the route between the U. S. and Europe by BOAC.

▶**Continental Airlines** common stock has been accepted for listing on the New York Stock Exchange, and trading will begin about mid-May. All trunklines are now listed on the New York Exchange except Northeast, which is listed on the American Stock Exchange.

▶**Deadline** for Emergency Board report to President Kennedy on the dispute between Northwest Airlines and its flight engineers has been extended from Apr. 24 to May 24.

▶**Domestic trunkline** interest on debt rose to $44.5 million in 1960, compared with $32.3 million in 1959 and $24.4 million in 1958.

▶**Federal Aviation Agency** has an agreement with the Air Force that will permit civilian jet flight crew members to take physiological altitude training. Basic course includes atmosphere physics, physiology of respiration and circulation, hypoxia and effects of altitude changes on the body and principles of vision.

▶**Hong Kong,** Indonesia, New Zealand and the Fiji Islands have agreed to take steps toward cutting immigration and customs red tape for air passengers and cargo. Changes were made as a result of proposals by International Civil Aviation Organization and International Air Transport Assn., which are campaigning to streamline all border clearance processes.

▶**Post Office Department** has proposed new postal rates which would increase air mail rates from 10 to 15 cents per half ounce between the U. S. and South America and from 10 to 13 cents between the U. S. and the Caribbean and Central American areas. Since 75% of the land area of the Soviet Union is in Asia, the Asian rate of 25 cents per half ounce would apply on all letters to Russia, rather than the 15-cent European rate now used for the western section.

Microdot Expands Telemetry Capability

South Pasadena — Microdot Inc. has recently acquired Spectralab Instrument Co. of Monrovia, California. The acquisition provides Microdot's Instrumentation Division with outstanding capabilities in the field of VHF and UHF cavities and related instrumentation. Spectralab has been widely noted for its recent scientific breakthrough in the new UHF telemetry field with the first operational UHF telemetry transmitter, and for its high power transmitter designed for the Pioneer V satellite. Spectralab instruments have also flown in the Redstone, Jupiter, Atlas and Pershing missiles.

The Pioneer V transmitter shown above is typical of the sophisticated instrumentation now offered by Microdot. This miniaturized unit features an output of 150 watts, ease of adjustment, and proven outer space reliability.

With the Spectralab acquisition, Microdot's telemetry capability now includes a broad product line ranging from sensing devices through transmitters. As a single source for instrumentation, Microdot can provide weldable strain gages, load cells, temperature probes, thermocouples, amplifiers, power supplies, signal conditioning equipment, power amplifiers, frequency doublers, oscillators and transmitters.

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Aerospace Investment Abroad: Part I

U.S. Firms Reappraising Foreign Licensing

By Cecil Brownlow

Geneva—Is U. S. aerospace industry's increasing plunge into the European market a strong long-term investment or is the drive for short-term profits simply creating a stiff, possibly unbeatable competitor who must be reckoned with tomorrow?

This is a question being asked in industry financial circles today and one that revolves primarily around the issue of how U.S. firms can assure themselves a place in the market on a continuing basis and with the least risk as Europe's industry absorbs the imported technologies it needs to stand alone.

What, for instance, are the relative potentials of license agreements as opposed to U. S. stock holdings in European firms and wholly-owned subsidiaries or jointly-owned companies and technical assistance pacts with their minimum outlays of capital?

To gain some insight into these questions—and into the increasing competition from Europe itself — AVIATION WEEK surveyed industries in 15 European nations, as well as those of the U. S. It also interviewed government and trade association officials on both sides of the Atlantic.

The picture that evolves is by no means a clear one since the safest, most profitable roads to the future are still a matter of open debate within the U. S. and among representatives of U. S. firms abroad.

"The old saw, 'sell your license, sell your soul,' no longer holds," one American representative in Europe says. "Now, it's big business."

"You sell a license," another counters, "and you sell your brains. . . . What you are doing is building up a firm that can be damned tough competition in the next go-round."

A proponent of wholly-owned subsidiaries believes full ownership is needed if the product offered is to be properly marketed and if full advantage of its sales potential is to be obtained. He says:

"You only establish a subsidiary in an area where you know the market is good, but, when you move into a place, you need complete control to protect your investment."

These are the theories, and they are often overridden by practical necessity. As an example, a company may favor jointly-owned firms, abhor license agreements, and find itself in the position of having to grant them to several European sources as a result of actions taken by the U. S. government or a prime contractor to which it supplies components.

However, the trend of most U. S. firms heavily entrenched in Europe seems to be a gradual evolution from outright license agreements, with few strings attached, to the purchase of substantial minority stock holdings in promising firms and/or, on a more limited scale, establishment of jointly-owned companies.

"This way," one spokesman says, "you have a toehold. A license agreement is a one-shot deal."

Be that as it may, license agreements still hold sway—and probably will for some time to come—and whatever their long-term value to the licenser, they must be credited with having played a leading role in the recovery of much of West Europe's industry from the rubble of World War II.

License agreements from the U. S. to Europe have predominated but, as the industry on this side of the Atlantic gains strength, more and more are being negotiated between the nations of Europe, both on a firm-to-firm and country-to-country basis. "Anti-licensee," or more accurately "reluctant-licensee," advocates within U. S. industry point to the latter trend as a probable portent of things to come with a resultant loss to American firms unless shoring-up protective steps are taken.

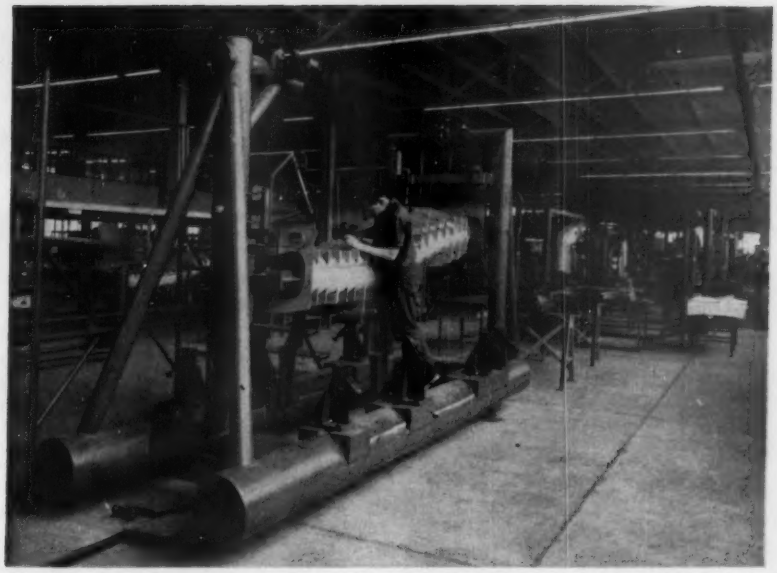
Present U. S. licenses run wide and deep, ranging in scope and magnitude from the much-publicized multi-nation European production program for Lockheed's F-104G interceptor-fighter-bomber (AW Mar. 13, p. 286) to overhaul agreements for American weapon systems and spare parts stationed in this area of the world.

They also transcend the present technological levels and immediate goals within Europe—and to this degree rebuff critics who contend that the present round of licenses is the least profitable one—and include such projects as the technical aid agreements with SEPR, the French rocket combine, signed by North American Aviation's Rocketdyne Division and Thiokol Chemical Corp.

The following breakdown, while not necessarily representative, gives some indication of the range of currently active license agreements flowing from the U.S. to Europe, excluding consortiums such as the F-104 project and pacts handled through or by firms that are subsidiaries, jointly-owned companies or those in which American industry has substantial stock holdings:

• **Lycoming Division of Avco Corp.,** production rights to Germany's BMW Triebwerkbau for the GO-480-BIA piston engine. Under the five-year pact,

MESSERSCHMITT production lines are turning out weapon system components under license from both the U. S. and Europe. German technicians (above), are assembling a forward fuselage section of the Lockheed F-104G.



WORKMAN at Messerschmitt's plant puts finishing touches to a Fiat G.91 air duct unit.

which is now being extended, BMW pays a fixed license fee plus royalties on engine and spares sold.

• **North American Aviation,** repair and modification rights on F-86 and F-100 aircraft to Construcciones Aeronautics S. A. (C. A. S. A) in Spain. Total of approximately 1,000 U. S. Air Force aircraft is involved in the agreement.

• **General Electric Co.'s** Flight Propulsion Division, production rights to de Havilland Engines, Ltd., for the T58 engine plus technical assistance.

• **General Electric,** production, repair and overhaul rights to Italy's Fiat for the J47 engine.

• **United Aircraft Corp.,** production rights to Fiat for the Pratt & Whitney R985 and R1830 piston engines plus Hamilton Standard propellers, blades and pitch change mechanisms.

• **Thompson Products, Inc.,** production rights to Fiat for turbo-engine parts.

• **Sikorsky Division of United Aircraft,** maintenance and inspection rights on Sikorsky metal-bonded blades in Europe to Holland's Royal Netherlands Aircraft Factories Fokker.

• **Douglas Aircraft Co.,** technical assistance agreement with Italy's Piaggio for development and marketing of a turbine-powered executive aircraft series.

• **Fairchild Engine and Airplane Corp.,** production rights to Italy's Siai-Marchetti for C-119 airframe spare parts.

• **Sikorsky,** production rights to Westland Aircraft, Ltd., for the S-58 helicopter plus a technical interchange agreement. Westland also has built the Sikorsky S-51 and S-55 under license.

• **North American's Rocketdyne Division,** technical assistance agreement with Rolls-Royce, Ltd., plus production rights for certain rocket motors in connection with Britain's Blue Streak IRBM program. Agreement is still in force despite the apparent demise of the Blue Streak.

• **Minneapolis-Honeywell,** production rights to British Aircraft Corp. for floated gyroscopes.

• **Continental Aviation and Engineering Corp.,** exclusive rights to Rolls-Royce for all Continental engine spares in Europe and for Rolls-Royce-built Continental engines in Australia and New Zealand.

• **Dynamic Developments, Inc.,** a Grumman Aircraft Engineering Corp. subsidiary, production rights to the Italian shipbuilder Cantieri del Tirreno for the construction of large hydrofoil vehicles.

• **Lockheed Aircraft Corp.,** production rights to Air France and Deutsche Lufthansa for tooling and certain spares for the Constellation transport series.

• **Lockheed,** production rights to Holland's Electrische Smederij for jetstack exhaust systems and turbine load assemblies.

• **Bell Helicopter,** production rights to Italy's Construzioni Aeronautiche Giovanni Agusta for the Bell 47J and 47G helicopters plus HU-1A rotating components for the Agusta 102.

• **Bell Aerosystems Co.,** technical assistance to the German Group of Messerschmitt, Heinkel and Bolkow working on a Mach 3 VTOL. Assistance revolves primarily around the Mach 2 Bell D-188A which reached the mockup stage before USAF development funds were cut off in 1959.

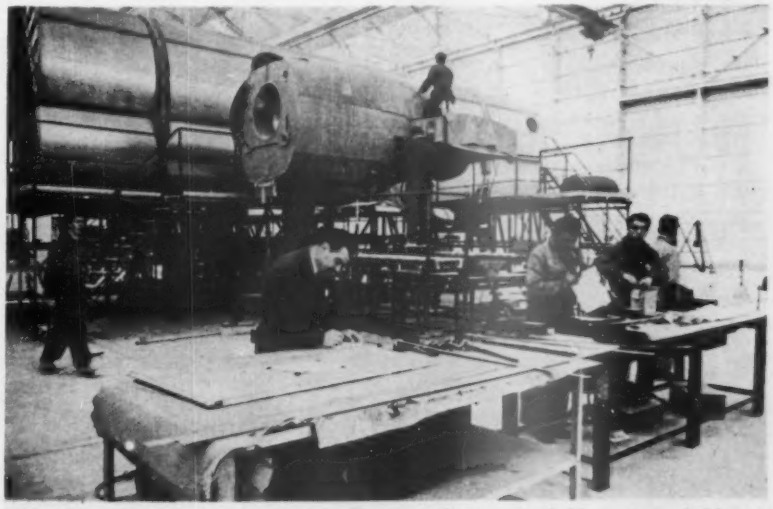
• **Beech Aircraft Corp.,** mutual agreement with SFERMA under which the French firm is converting the Beech Baron executive aircraft to Turbomeca Astazou turboprop engines.

• **Lockheed,** mutual agreement with France's Breguet for repair of North Atlantic Treaty Organization aircraft.

From the standpoint of immediately recognizable profits, segments of the U. S. industry have, of course, found their greatest harvests in the European consortiums that have banded together through necessity for the production of such complex weapon systems as the F-104, the Hawk anti-aircraft and the Sidewinder air-to-air missile systems.

In the F-104 program, Lockheed is supplying a total of 126 aircraft directly to West Germany from its U. S. production lines and will collect license fees on another 949 planes presently scheduled to be built in western Europe between late this year and 1965.

North American Aviation will collect on direct sales and license rights to its NASARR fire control system for the



COMMON EUROPEAN production of a European design, a probable portent of things to come, is exemplified by the Breguet 1150 Atlantic ASW aircraft. A NATO project, Atlantic components are being fabricated in the industries of four nations. In the picture above, the midwing section of the first prototype is being mounted to the fuselage.

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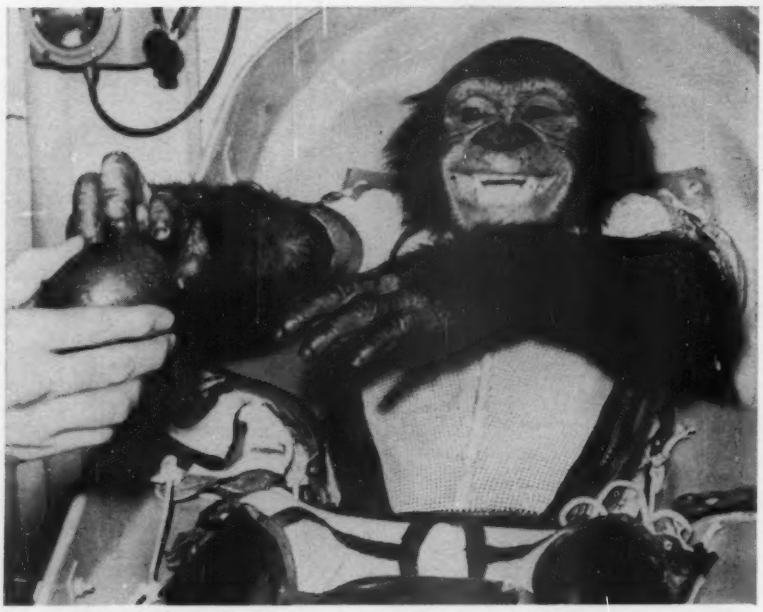


Ham gets an apple after 420 mile space ride. Ford Instrument control system components were in NASA's MERCURY-REDSTONE vehicle that powered the flight.

Guidance and control system components for the MERCURY-REDSTONE vehicle that successfully carried the now famous chimpanzee, Ham, on his flight into space were furnished to the National Aeronautics and Space Administration under a contract for guidance and control hardware with Ford Instrument Company.

This flight, a historic event, as well as a dramatic preview of the MERCURY "man-in-space" spacecraft, marks Ford Instrument participation in still another of a long line of missile and space "firsts."

Among others: A Ford Instrument built control system directed the JUPITER C which carried the Free World's first satellite into orbit. Ford Instrument guidance and control system on a JUPITER carried the monkeys, Able and Baker, into their successful trip through space. And Ford Instrument guidance and control on the JUNO II sent America's first space probe past the moon and into orbit around the sun.

In 1961, Ford Instrument will have marked up 12 years in missile guidance and control.

Novel Technique Used for Analog-to-Digital Conversion

All-Solid-State Converter Handles A-C, D-C and Synchro Voltage Inputs

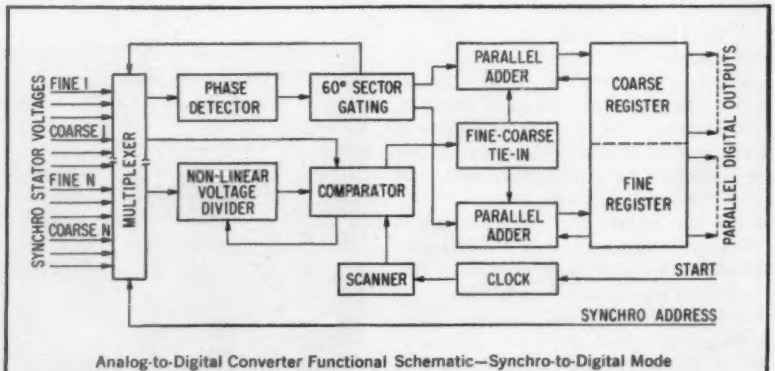
An unusual technique is employed in Ford Instrument's new all-solid-state analog-to-digital converter to reduce A-C, D-C and synchro signals to digital form, it was revealed recently. The high level of multiplexing and the use of no moving parts represents a significant advance in conversion technology.

The highly reliable technique for converting synchro signals into digital form is particularly interesting.

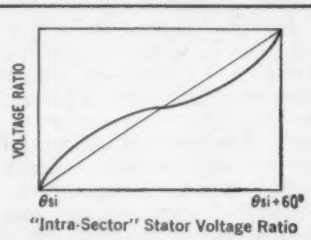
First, observation of the polarity of the three stator signals relative to the rotor voltage, uniquely defines the 60° sector position of the rotor

Second, the ratio of two of the stator voltages defines the intra-sector magnitude. This ratio is obtained by systematically comparing two stator voltages. Parallel addition of the sector and intra-sector data yields the desired solution, to 10-bit accuracy with single-speed or 15-bit accuracy with two-speed (36:1) inputs.

These circuits are part of the Ford Instrument developed all-solid-state, multiple-input data converter—being manufactured for several military systems. Want to put experience like this to work for you? Write to address on next page.



Analog-to-Digital Converter Functional Schematic—Synchro-to-Digital Mode



"Intra-Sector" Stator Voltage Ratio

data bulletin

Developments at Ford Instrument Co., Division of Sperry Rand Corporation, that are of particular interest to users of special-purpose computers and controls.

LONG ISLAND CITY 1, N. Y.

New "Digital Platform" Completed

Designed by Ford Instrument for Wright Air Development Division

Completed, and being given final check before its flight test, are the components for the AN/AJN-7 inertial navigation system, a "flyable breadboard" model of which is expected to be flight tested in early summer.

Designed and built at Ford Instrument, the new system will mount gyros directly to the frame of the airborne vehicle instead of on a conventional stable platform. The inertial sensors are, as shown above, equipped to provide digital outputs. The gyro outputs are processed through a digital computer, FORDAC (Ford Attitude Computer), which performs the functions of the conventional platforms. The accelerometer information is combined with the FORDAC outputs in a second computer, nicknamed "POCO" (Position Computer) which computes the position of the vehicle with respect to a fixed reference frame.

The system represents a new concept in inertial navigation by performing mathematically the functions that are usually performed by the stable platform. The computers are of all-solid-state design.

The AN/AJN-7 system has been developed, designed and built at Ford Instrument Company for the U. S. Air Force Navigation and Guidance Laboratory of Wright Air Development Division.

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Responsible agencies or industries, possessing the requisite security clearance and need to know, are invited to learn more about Ford Instrument capabilities. Ford Instrument Liaison Engineers are always ready to discuss your new or special requirements, and will be glad to provide you with detailed information on specific project capabilities.

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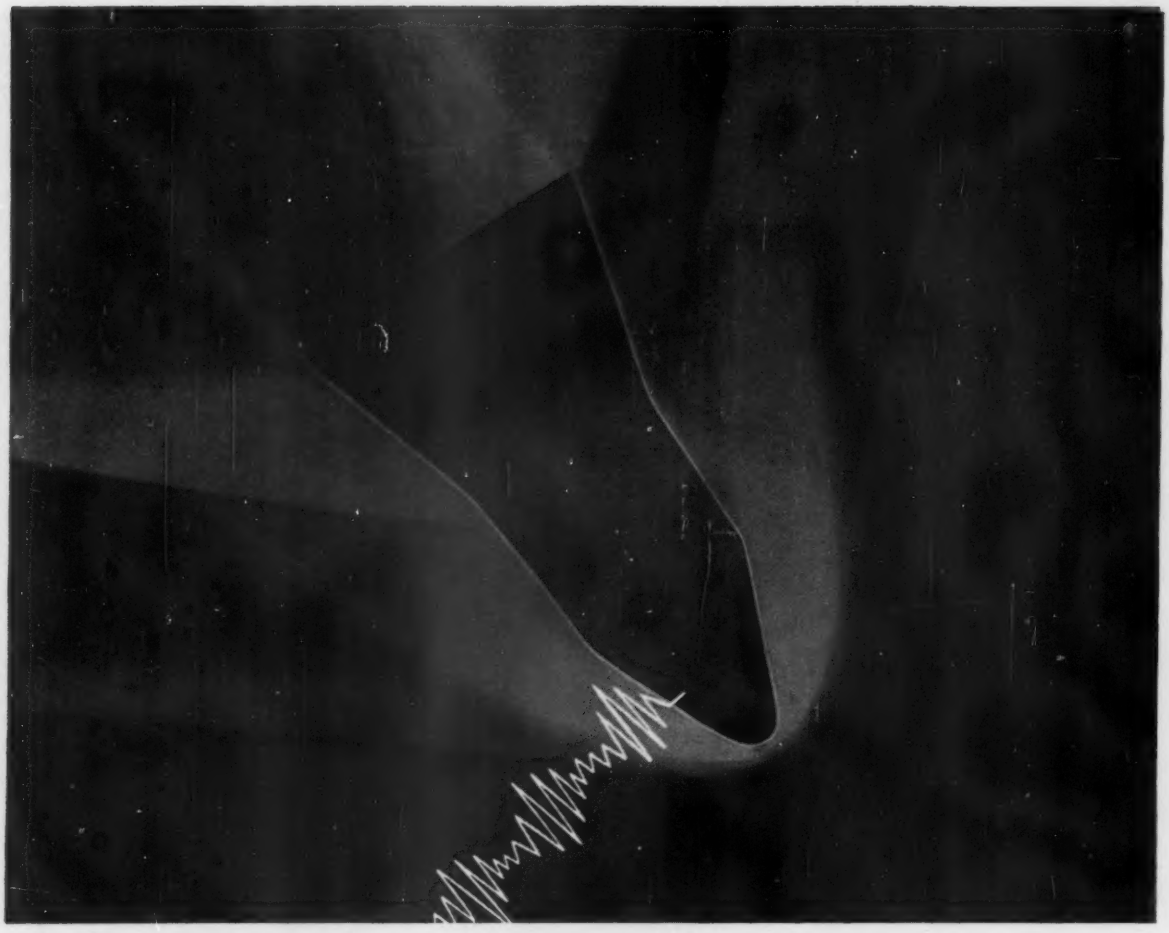

Piercing the plasma sheath...

When ICBMs, satellites or space probes re-enter the earth's atmosphere, frictional heating is so intense that air surrounding the vehicle becomes a "plasma sheath." This acts as a barrier to conventional radio telemetry. AVCO/RAD has developed a Direct Re-entry Telemetry (DRET) system for the U. S. Air Force. The DRET system has been flown on Atlas and Titan ICBMs and has successfully transmitted signals to airborne monitoring equipment. Engineers and scientists at AVCO/RAD are also working on techniques for continuous communications with re-entering manned vehicles, as well as on other conditions in which a plasma barrier exists and where signal penetration is required.

Airborne re-entry tracking team of Avco's RAD Division monitor an Avco Mark 4 re-entry vehicle launched by Titan ICBM.

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F-104 as will General Electric on European production of the J79 powerplant. A number of other U.S. suppliers also stand to profit handsomely.

Aside from providing the European firms involved with a major opportunity to take a long step forward in improving their technological and production capabilities—and possibly creating future competition for the U.S. as they do—the F-104 program is contributing much toward keeping some of the firms involved on a sound financial basis today.

Major airframe contractors include Germany's Messerschmitt, Heinkel, Dornier, Siebel, Focke-Wulf, Hamburger Flugzeugbau and Weserflugzeugbau; Holland's Fokker and Aviolanda; Belgium's SABCA and Avions Fairey, and Fiat in Italy. Prime powerplant manufacturers are Germany's BMW Triebwerkbau, the Belgian FN Works and Fiat. From here, the subcontracts flow deep into the business of the smaller contractors of the nations concerned.

Holland's Aviolanda, as an example of the program's impact, estimates that its contract will be worth $25 million, and that it will represent 65% of the company's gross business during the five-year period it is in force.

Technological Boosts

The Hawk and Sidewinder programs are performing similar functions, boosting western Europe's technological level, providing added profits for U.S. concerns. And, more multi-nation production of American systems may be in the offing.

Hardware now under consideration includes Convair's Redeye low-altitude anti-aircraft weapon for the infantry, the Army-Martin Pershing tactical range missile and the Chance Vought Scout low-cost space booster.

The consortiums, however, are also providing their share of headaches and point up one of the weaknesses of the license system whereby the licenser loses much of the day-to-day control of his product.

Another matter of debate is just how such programs should be managed—as loosely-knit, multi-nation projects, as in the case of the F-104 and Sidewinder, or as official NATO consortiums. Proponents of the latter argue that the decision process and chain of command is strengthened, red tape and custom barriers slashed if a program is clothed in the NATO mantle. Its opponents say NATO participation simply adds another layer of bureaucracy.

The Hawk project, as a "subsidiary body" of the NATO, is managed directly by the NATO Hawk production organization staffed by representatives of all the nations concerned.

Under licenses issued at NATO request by Raytheon, Aerojet-General and other U.S. firms, European companies of five nations have banded together to form a French incorporated production supervisor known as Societe Europeenne de Telequidage (SETEL) with headquarters in Paris.

Participating European firms, each with component and subassembly responsibilities, are Ateliers de Constructions Electriques de Charleroi (ACEC) of Belgium, Thomson-Houston (CFTH) of France, Telefunken of Germany, Finmeccanica of Italy and N. V. Philips of The Netherlands. SETEL also has sublicensed Hawk motor production to the Ministere des Armeses, Direction des Poudres, of Paris, and Aerochemie S. P. A., of Rome.

Prime European contractor for the multi-nation Sidewinder program, which bears the loose designation of a "NATO-sponsored project," is the Fluggeratewerk Bodensee division of Bodenseewerk Perkin-Elmer and Co., a German subsidiary of Perkin-Elmer.

Full list of participating firms has not yet been disclosed since some are still undergoing security clearances before final contracts are signed.

Those in the program, however, include Belgium's Les Forges de Aerbrggee, Germany's Nitrochemie GmbH. and C. A. Steinheil Sochne GmbH., Philips of The Netherlands, Norway's Kongsberg Vapensabrikk and Raufoss Ammunisjonssabrikker and Portugal's Standard Electrica, a subsidiary of International Telephone and Telegraph Corp.

"Most of these people are eager to work with us. They know they're taking a big step, and they want to learn," one U.S. representative involved says. "But," he adds, "you run into others who think they know everything there is to know. You can't convince them that this is a fairly big step beyond anything they've done before. They just want you to hand over the blueprints and stand back."

Over-all extent of the U.S. industry's investment in licenses, stock holdings, etc., is almost anyone's guess. Many firms are wary of discussing license agreements, much less capital outlays involved in stock purchases or establishment of a subsidiary, for a variety of reasons—competitive and otherwise.

This general reluctance was recently highlighted by the response to an Aerospace Industries Assn. suggestion to its industry members that a dossier of their foreign commitments be compiled as a reference and benefit to all.

Most members simply declined to reply.

The majority of those that did reply registered opinions that were less than enthusiastic, and the tentative plan was permitted to die quietly.

Industry commitments abroad,

Engineered Environment

Although vulnerable to heat, the spittle bug can blow himself a cooling bubble bath and thus "tailor" his environment to suit his needs.

Tailoring of environment is a vital requirement that must be built into today's weapons systems. Answering this need is specially designed AAF equipment for controlled environment. For example, AAF-engineered air conditioners were developed for the APCHE system. The units are installed in mobile vans used for prelaunch checkout of the Atlas missile. They provide conditioned air for personnel and for sensitive electronic equipment in the van.

Other AAF equipment supporting modern weapons systems include heating equipment utilizing various fuels or electric power, also packaged liquid chillers, heat exchangers, specialized blowers. You can increase your system reliability with AAF know-how and equipment.

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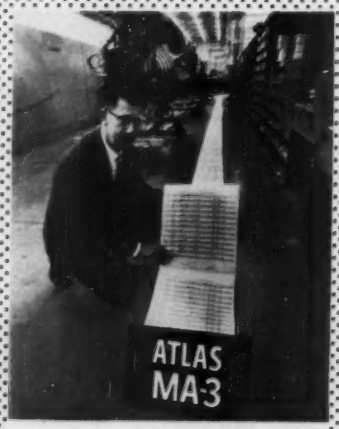
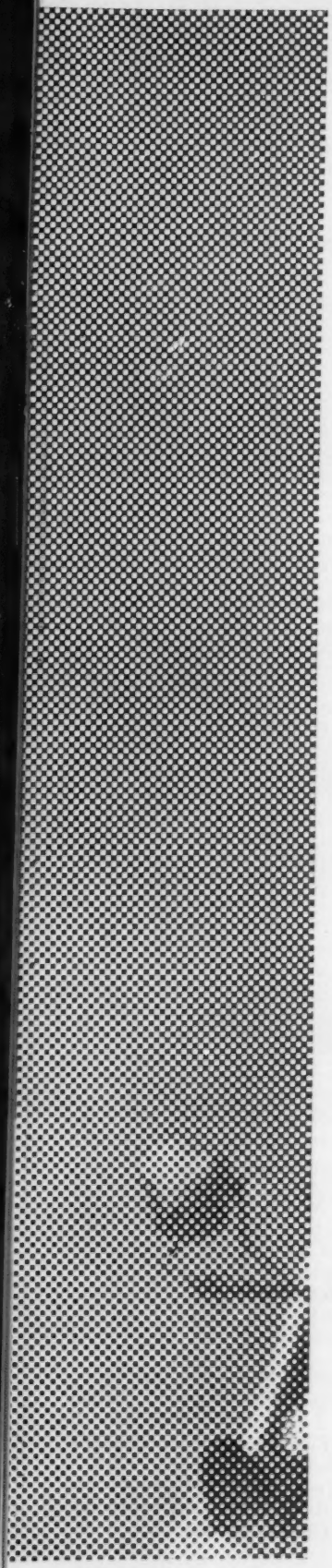


Computer-listed master catalog of engine parts reduces production lead time at Rocketdyne.



Keeping the cost of space down to earth

Behind the thundering performance of Rocketdyne's engines, a significant reduction in the cost of power for America's missiles has been quietly achieved. Today, Rocketdyne engineering skill and efficient production methods make it possible to power two missiles for the cost of one in 1957.

Rocketdyne, the pioneer in rocket science, was first with power for America's long range ballistic missiles—first with power for outer space. In establishing this technological leadership, Rocketdyne developed new management concepts at every level of operation, from early design through final testing. The result is outstanding technical achievement at the lowest possible cost.

In data processing alone, advanced techniques are saving engineers hundreds of hours of experimentation and testing and have contributed to a 37 percent reduction in Atlas engine costs for the Air Force. An intracompany communications network links test stands and research laboratories in Missouri, Texas and California; gives management the daily status of every program—whether it's on schedule, what parts are in short supply, how the production line is performing.

Through research, engineering, and management, Rocketdyne is constantly at work not only to increase thrust performance and develop new propulsion techniques, but at the same time to reduce costs all along the line.

34 of America's 38 successful satellites and space probes have been launched by Rocketdyne engines.

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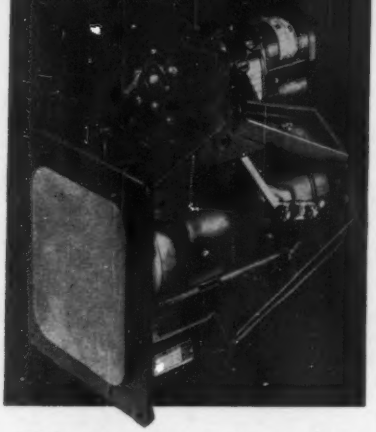

This ram air scoop is another example of AiResearch's ability to design and integrate structural and electromechanical systems for control functions.

Through its use, air is provided for emergency cabin pressurization and the cooling of electronic components. The unit is composed of a retractable aluminum ram air scoop, extended and withdrawn by a 400 cycle rotary actuator, a self-contained 350 watt heating element and an integral check valve.

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Your inquiries are invited.

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whether they border upon a question of security or not, generally must be cleared through the State Department, which, in turn, fans out the requests for comment to either the Department of Defense or the Commerce Department, depending upon their nature.

These agencies, however, insist that no record as to totals or extent is maintained by them, adding that any attempt to monitor the requests on such a basis may lie well beyond the purview of their operation and violate the rights of the companies involved.

"The Internal Revenue people are the only ones who might be able to come up with a figure," a Commerce Department official said recently. "We don't have it, and we couldn't look at the tax records if we wanted to."

But the commitments are growing and are often fiercely fought over. Increasingly, they are being paced in scope by agreements between the nations of western Europe with little or no U.S. involvement.

Germany is building the Fiat G. 91 close-support fighter; Rolls-Royce and M. A. N. Machinen Fabrik Augsburg-Nuremburg) are cooperating on the development of high-performance VTOL powerplants; W. G. Armstrong-Whitworth in Britain and Saab Aircraft Co. in Sweden are producing supersonic target drones developed by France's Nord Aviation; Spain's C. A. S. A. is building Dornier's Do. 27 lightplane; Klockner-Humbold Deutz is tooling to build Bristol-Siddeley's 5,000-lb.-thrust Orpheus turbojet engine for German-produced G. 91s.

Potez Air Fouga's Magister jet trainer has been produced under license in Germany (on a joint basis by Messerschmitt and Heinkel), Finland (Valmet Oylentokometehdas) and Israel Aircraft Corp.

Working within the framework of NATO, Dornier, Fokker, SABCA and Avions Fairey are joining France's Breguet in production of the latter's 1150 Atlantic ASW patrol plane which will be powered by two Rolls-Royce Tyne turboprop engines. Nord and Germany's Hamburger Flugzeugbau are building the first prototypes of the Transall C. 160 turboprop transport scheduled to replace the piston-engine Noratlas 2501, also built on a cooperative basis by the two firms plus Flugzeugbau Nord.

Bipartite and tripartite agreements within and outside the scope of NATO are gaining at a commensurate rate, a manifestation of Europe's desire to build its own whenever possible.

Germany, with the money to spend but without the facilities and technicians to satisfy its aims, is the current leader in this area, maintaining pacts with Great Britain for a VTOL close-support fighter to fit a present NATO requirement, another with France for a high-performance VTOL interceptor to meet a NATO requirement it hopes to generate, and still another with France and Italy covering a broad spectrum for development and production of a family of helicopters.

This determination to spread its own wings once again with advanced designs of products that bear the imprint of German development work is the major reason behind recent, and substantial, U.S. investments in the country in the form of stock purchases and establishment of joint firms.

"The Germans," a U.S. representative here says, "want their own products, and they want to deal with German firms whenever possible. They'll work under a license when they have to, but they want to do all they can on their own. They want to see a German stamp on the end product."

If and when a truly European space effort moves beyond the paper stage, the overriding need to pool fiscal, technological and facility resources will take precedence over nationalistic demands in some quarters for individual programs.

The European nations, however, are split as to the objectives and breadth such a project should have. For the moment, they most probably will continue to look to the U.S. for the necessary booster systems while developing their own payloads for prestige and scientific purposes. This could, and would, change if and when a common production program for the Scout becomes a reality and production is begun.

Such splits generally have large political overtones, and the tug between Common Market and Outer Seven considerations in the economic sphere is sometimes felt, seldom enough, however, to overcome the realities of need and/or political advantage.

Switzerland, as an example, ignored Sweden, its Outer Seven partner and fellow neutralist, in the selection of a new jet fighter. Sweden, gambling on its close ties and a good product, pushed hard for the Saab Draken. France, a Common Market member but with tariff reductions to offer, pushed just as hard for the Dassault Mirage III-C and won.

As in the case of the U.S. agreements, the European license pacts run the technological gamut and include the following:

• **De Havilland Engine Co., Ltd.,** production rights for Ghost and Goblin powerplants to Italy's S. I. C. M. A., Sweden's Flugmotor and Switzerland's Service Technique Militaire.

• **Piaggio,** production rights to Focke-Wulf for the P.149 primary trainer for the West German air force. Fock-Wulf-

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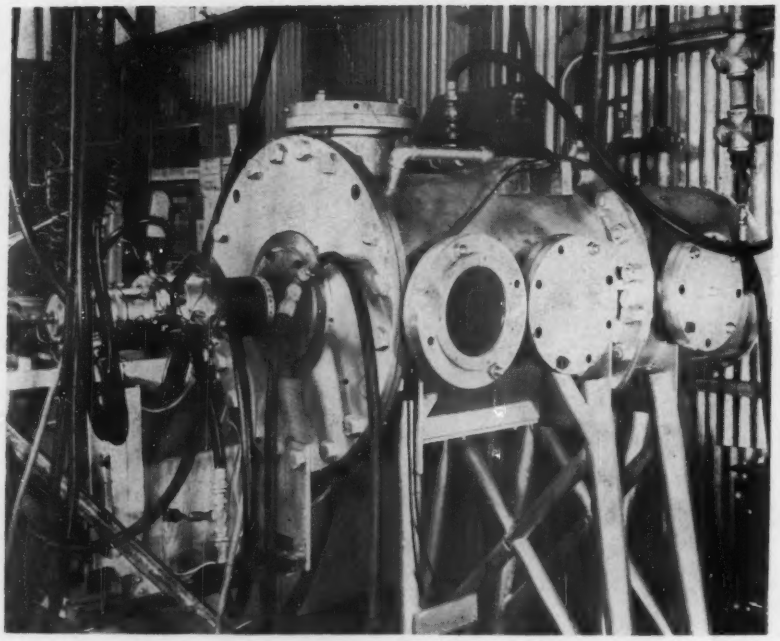


Hyperthermal Tunnel Marketed

One megawatt arc-heated hyperthermal tunnel for testing of heat transfer and materials behavior on hypersonic space vehicles is now marketed by Plasmadyne Corp., Santa Ana, Calif. Tunnel simulates stagnation enthalpy and pressures, ranging between 10,000 fps. and 30,000 fps. using a 3-in. dia. Mach 3 test section. Simulated altitudes of 100,000 ft. (at 10,000 fps.) or 200,000 ft. (at 30,000 fps.) are possible.

built P.149s are powered by Lycoming engines produced under license by BMW Triebwerkbau.

• **France's Turbomeca,** production rights to Britain's Blackburn Engine Co. for a range of small gas turbines. Blackburn estimates that production permitted by the agreement represents between 80% and 90% of its current business. Pact is scheduled to expire next year but may be renewed.

• **Bristol Siddeley Engines, Ltd.,** production rights for tubular bodies to Nord Aviation.

• **Bristol Siddeley,** production rights to Dassault for the M. D. 30 Viper powerplant.

• **Italy's Oficina de Bernardi,** production rights to Germany's Merckle Flugzeugwerke GmbH for the M.d.B 02 Airscooter sports plane.

• **Bristol Aircraft, Ltd.,** production rights for drop tanks to Belgium's SABCA.

• **Dunlop Rubber Co., Ltd.,** production rights to SABCA for brake control equipment for Belgian air force Avro CF-100 and Hawker Hunter aircraft.

• **Italy's Aviamilano,** production rights to its compatriot, Aeromere, for the Falco F. 8L sports plane.

• **Switzerland's Contraves,** production rights to Germany's Bolkow for the Cobra anti-tank missile system.

In the engine field, Rolls-Royce now holds the lead and, with technical assistance agreements on advanced projects, is working to keep it despite serious bids by other British, U. S. and French manufacturers. Active agreements include pacts with:

• **Royal Swedish Air Force Board** for production of the Avon RA. 7, RA. 24 and RA. 28 turbojet engines by Svenska and Flygmotor.

• **Belgian government** for production of the RA. 7 and RA. 24 by Belgian FN Works.

• **France's Hispano-Suiza** for production of the Avon and Tyne engines. The Hispano-Suiza Tyne will go into the Franco-German Transall C. 160 transport.

Increasing Role

An increasing European role is a natural consequence of its technological resurgence on a broad front, but U. S. industry officials say governmental red tape is plaguing their efforts to battle these firms on an equal basis.

The route of an application by a U. S. firm requesting permission to grant a license agreement is often long and tortuous. Some disappear into the maze of government channels for periods ranging up to eight months before approval is finally given, according to an industry spokesman, "and by this time, the British or French have moved in on us and sewn up the deal." He adds:

"A large company with a Washington representative can often get things done fairly fast, but I pity the poor guy who doesn't know anyone and has to work by mail or telephone."

Under current procedures, the application is submitted to the State Department which, in turn, passes it along to the Defense Department's International Division for Security Affairs for comment if it deals with military hardware or to the Commerce Department if the product involved is of a purely commercial nature.

Defense Department, if it receives the application, then passes it along to the interested services for security screening, and this, a U. S. representative in Europe says, "can sometimes get ridiculous.

"We have a device that SHAPE (Supreme Headquarters Allied Powers Europe) says it must have. So, we went back to Air Force for clearance.

"They told us SHAPE could have Item A all right but not Item B since it's still classified. The trouble is the device won't work without both Item A and Item B.

"We've gone back and told the people at SHAPE what the Air Force said, and they're furious. So, we're just standing back now letting SHAPE and the Air Force do the head bumping."

Once the individual services have had their say, an application is passed back to the Defense Department for a further screening and then to the State Department again where, all other things being equal, it's weighed for its political implications, good or bad.

If the request has passed all the necessary hurdles, the applicant then receives a formal letter from the State Department giving him the go-ahead to conclude the agreement. The approval, however, is restricted and tightly controlled.

"Everytime we want to make a modification in a piece of equipment or crank in a state-of-the-art improvement we have to go through the whole mess all over again," one official complains. "And, the same goes if we want to sell it in a country not covered by the original application."

Industry spokesmen in Washington are working toward, and hoping for, a change, particularly in areas where security clearly is not involved—"the British can practically sell something off the drawing board while we sit around watching."

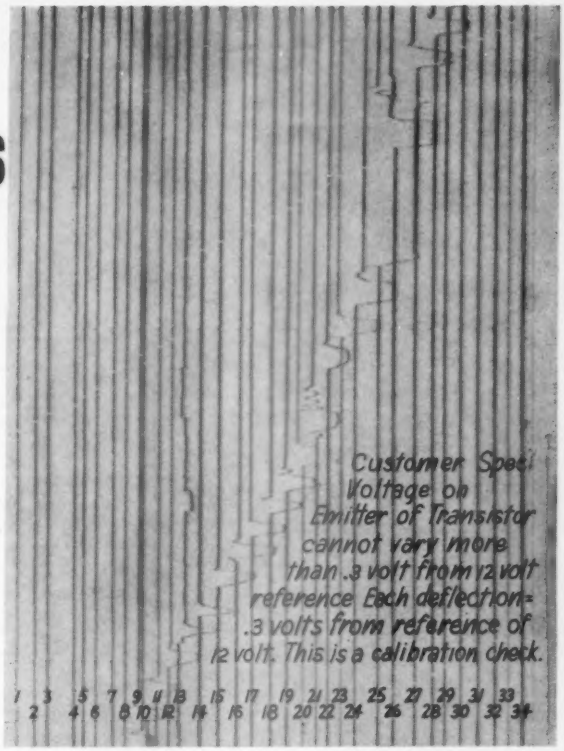
They aren't accepting bets, however, that they will be successful.

(This is the first in a series of articles dealing with U. S. investments and license agreements within Europe and the increasing competition from European firms. Subsequent articles will deal more fully with U. S. stockholdings, jointly-owned firms and subsidiaries abroad, their effect on the "dollar flow," and the move of the European industry into U. S. markets and elsewhere.)

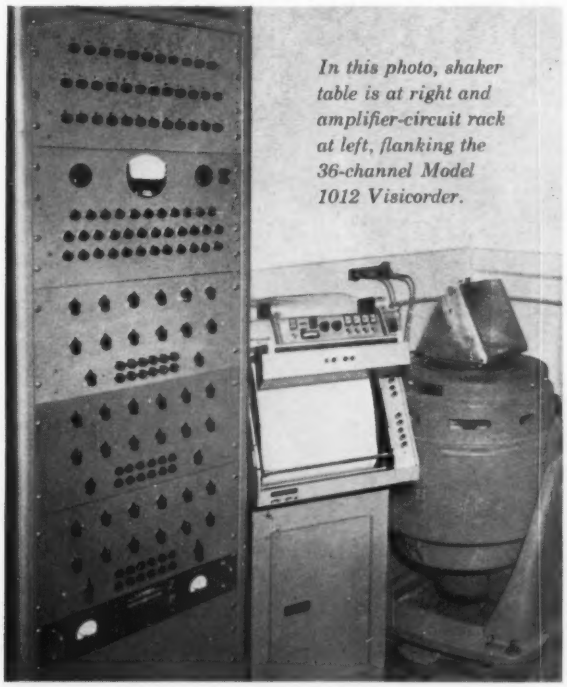
The VISICORDER records transistor torture

Transistors often have to work under incredibly severe environmental conditions. Production-testing them gave engineers at Honeywell's Semiconductor Division a chance to exploit the great versatility of the 36-channel Visicorder oscillograph Model 1012.

A certain order of transistors had to withstand vibrations of 10G at 10 to 2,000 cps without failing during the test or as a result of it. A standard test had been to measure the transistor's performance, next subject it to non-active vibration (not in any circuit), and then re-measure. This approach was obviously deficient as it did not reveal *operating* characteristics during test, nor did it disclose *intermittent*-type failures.



Unretouched record of vibration test on 36 transistors, each active in its own circuit during test.



In this photo, shaker table is at right and amplifier-circuit rack at left, flanking the 36-channel Model 1012 Visicorder.

The customer's quality requirements were stringent (AQL = .4%) and the large test sample required ruled out the use of an oscilloscope. The 3-hour test would have made a battery of scopes and operators necessary; transient defects would be missed due to eyestrain, fatigue, etc.

The Model 1012 Visicorder was chosen for the task as it simultaneously measures and records 36 channels of test information throughout the test period. The Visicorder instantly and directly records transients, no matter how random.

A Visicorder record like this is always a welcome supplement to your test data—your customer will be able to read it quickly and with full understanding. And it is a *permanent* record which *he* can show to *his* customer, if necessary.

For further information on how Visicorders can help to solve your instrumentation problems, contact your nearest Honeywell sales office without delay. Or write for Catalogs HC 906, 1012, 1108 and 1406, to:

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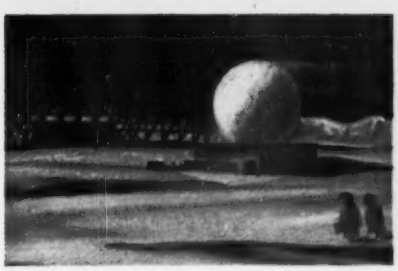

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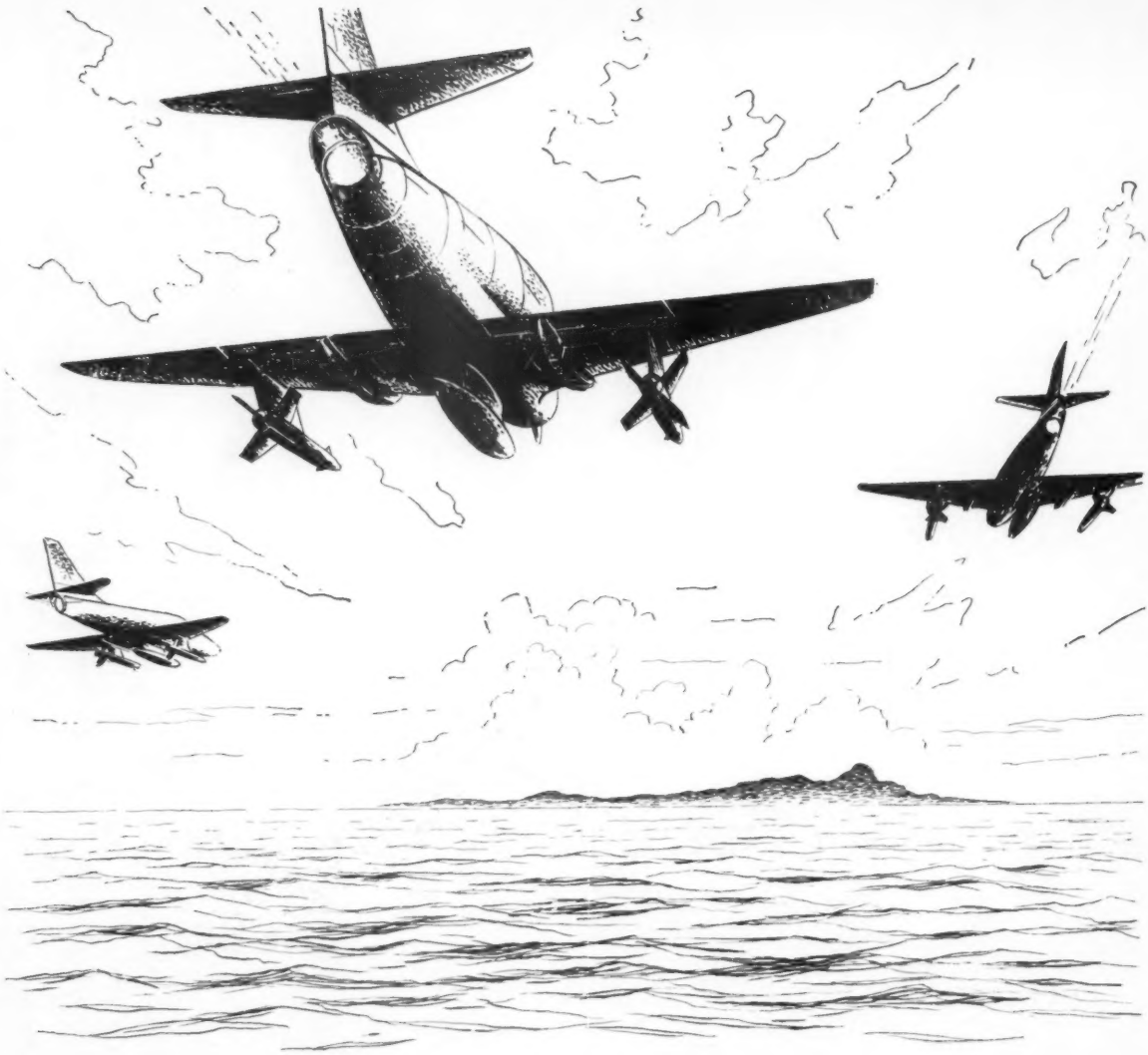

NAVIGATION OF TACTICAL AIRCRAFT

To reach the target — deliver the payload — and return home safely under all weather conditions are prime objectives of the tactical aircraft's mission. Required operating factors include speeds up to Mach 2, accurate navigation over land and water, from the deck to 70,000 feet, and greatest possible freedom from detection. Positive, low-level target identification and utmost accuracy of the weapon delivery maneuver are also essential.

LFE has developed Doppler Navigation Systems that are especially suited to tactical aircraft. They are operable within scramble time — function in winds up to hurricane velocity — are unaffected by cloud and rain back-scattering — have low power outputs — are virtually impossible to detect, jam or decoy — measure ground track velocity to better than 0.2% — and are completely compatible with nav-bomb and fire control computers.

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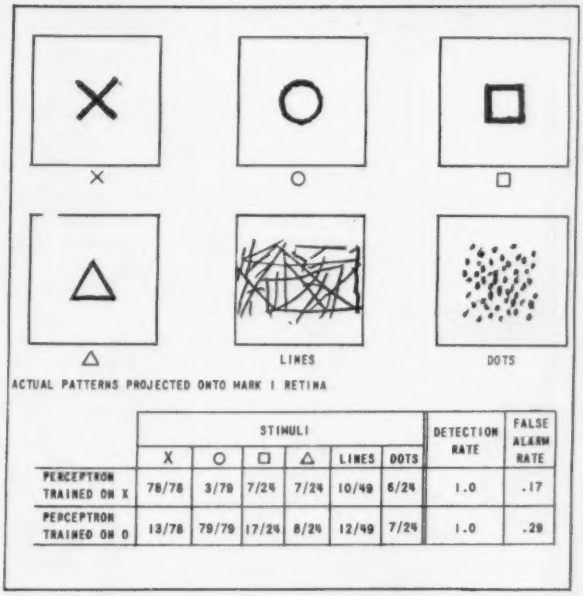
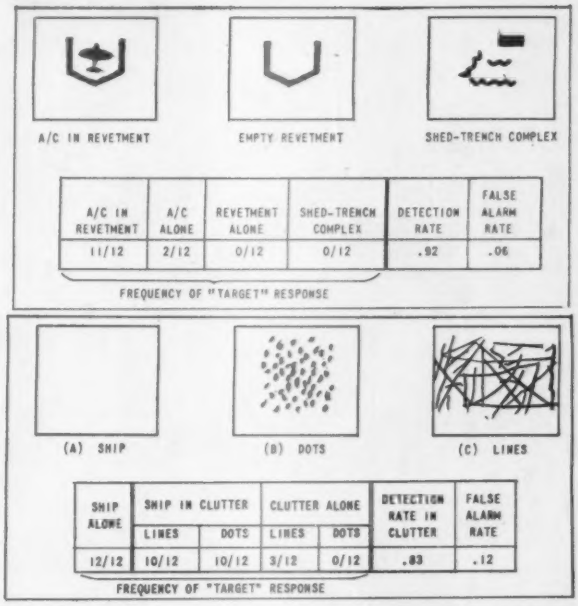


	STIMULI						DETECTION RATE	FALSE ALARM RATE
	X	O	□	△	LINES	DOTS		
PERCEPTRON TRAINED ON X	78/78	3/79	7/24	7/24	10/49	6/24	1.0	.17
PERCEPTRON TRAINED ON O	13/78	79/79	17/24	8/24	12/49	7/24	1.0	.29

SIMPLE targets shown were first used in recent experiments to evaluate possible use of Perceptron type machine to spot targets automatically in reconnaissance photos. Tests, conducted by Cornell Aeronautical Laboratory, showed 100% detection of such targets with only a moderate number of false alarms.



A/C IN REVETMENT	A/C ALONE	REVETMENT ALONE	SHED-TRENCH COMPLEX	DETECTION RATE	FALSE ALARM RATE
11/12	2/12	0/12	0/12	.92	.06

FREQUENCY OF "TARGET" RESPONSE

SHIP ALONE	SHIP IN CLUTTER		CLUTTER ALONE		DETECTION RATE IN CLUTTER	FALSE ALARM RATE
	LINES	DOTS	LINES	DOTS		
12/12	10/12	10/12	3/12	0/12	.83	.12

FREQUENCY OF "TARGET" RESPONSE

LATER experiments used pseudo-realistic targets shown above. Simple black-and-white images were used because of limitations in Mark I Perceptron retina. Machine was very successful in recognizing aircraft in revetment and in detecting ship despite presence of clutter, with only modest number of false alarms.

Perceptron Tested for Photo Analysis

By Philip J. Klass

Washington—Recent tests indicate that self-learning machines of the Perceptron type (AW July 4, p. 72) can be trained to recognize targets of interest in aerial reconnaissance photographs, easing a serious bottleneck to the effective use of meteorological and reconnaissance satellites.

Results of the tests, conducted by Cornell Aeronautical Laboratory under Office of Naval Research sponsorship using the Mark I Perceptron, were reported by CAL's Albert Murray here during a recent meeting of the American Society of Photogrammetry.

The problem of making effective use of the vast number of photographs obtainable from satellites is pointed up by the 23,000 photos produced by Tiros I meteorological satellite in its brief 2½-month period of operation.

Analysis of photos produced by a military reconnaissance satellite, such as Samos, to spot targets and other information of military value is estimated to require tens of thousands of man-hours for each hour the satellite spends over unfriendly territory.

Objective of the Office of Naval Research-sponsored tests was to evaluate the ability of a very elementary, modest-size machine to scan large quantities of photos, searching for a few kinds of objects, such as ships at sea or missile sites in the Arctic. This is considered only a starting point for more sophisticated machines which might locate special target shapes despite obscuring natural or man-made environment surrounding the target.

Test Conclusions

Based on the Mark I Perceptron tests, Cornell Aeronautical Laboratory scientists have reached the following conclusions:

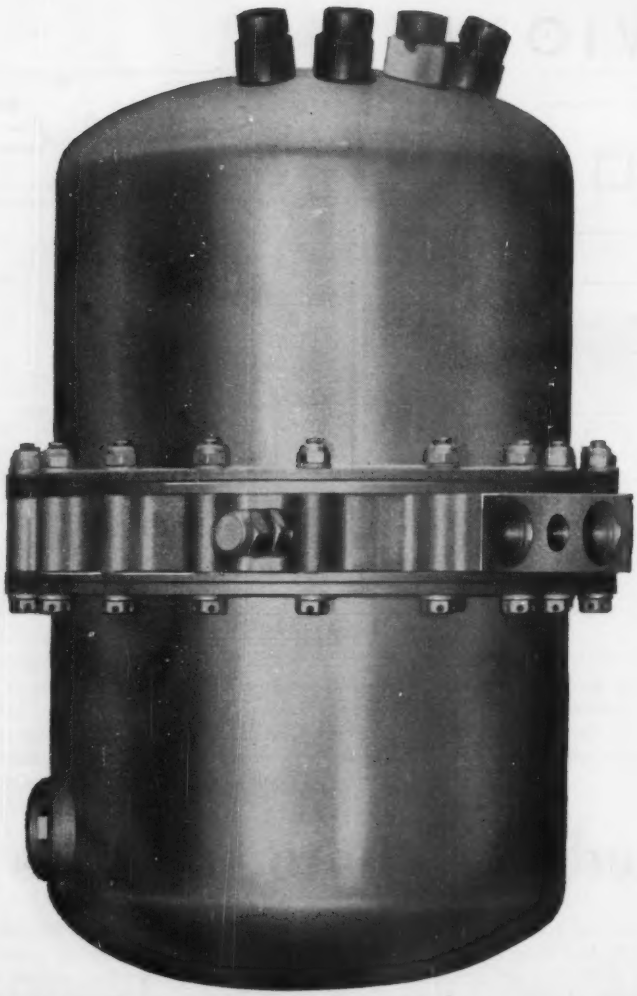
- **Target recognition** is relatively easy and quite reliable when the machine is properly trained. This applies whether the target is alone or in company with other objects.
- **False alarm rate** can be high for forms which resemble the shape of a target unless the machine is given "negative training" to ignore such objects.
- **Machine is apt to be confused** if targets and similarly shaped non-target objects both appear on the same photograph.

From a practical standpoint, the difficulty in discriminating between targets and similarly shaped non-target objects is not a serious handicap. The major need for automation is to sort through hundreds of thousands of photographs which are of no meteorological or military value, picking out the tiny fraction of frames that are of potential value. These could then be analyzed by human operators.

The important factor is that the machine did not overlook any potential targets, and from this viewpoint the CAL test results are encouraging, Murray indicated.

In the initial experiment, CAL scientists exposed the Perceptron's photoelectric "eye" to "X's," circles, squares, triangles, random lines and random dots. (The "eye," or retina, consists of 400 photoelectric cells.) In order to conduct two tests simultaneously, the Perceptron's 240 association units (called A-units) were divided in half, in effect creating two separate Perceptrons each with 120 A-units. One of the machines was trained to identify "Xs" while the other was trained to recognize circles.

During the course of this experiment, the Perceptron's eye was exposed 78 times to the "X," 79 times to the circle, 24 times each to the square, triangle and random dots and 49 times to the random lines to determine how many times the one split machine could correctly identify the "X" and how



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often the other correctly could identify the circle. Also recorded were the numbers of "false alarms," i.e., when the machine(s) thought one of the other symbols was an "X" or a circle.

The machine trained to identify the "X" as a target and the other trained on circles both hit 100% in spotting every trained-target viewed. The machine trained to identify "X's" experienced a 17% false alarm rate, i.e., falsely identifying other shapes as "X's" 17% of the time, while the machine trained on circles had a false-alarm rate of 29% in these tests.

The machine trained on X-shaped targets had the most false alarms when exposed to the random lines, while the circle-shaped target-trained machine had the most difficulty in distinguishing between circles and squares.

Negative Training

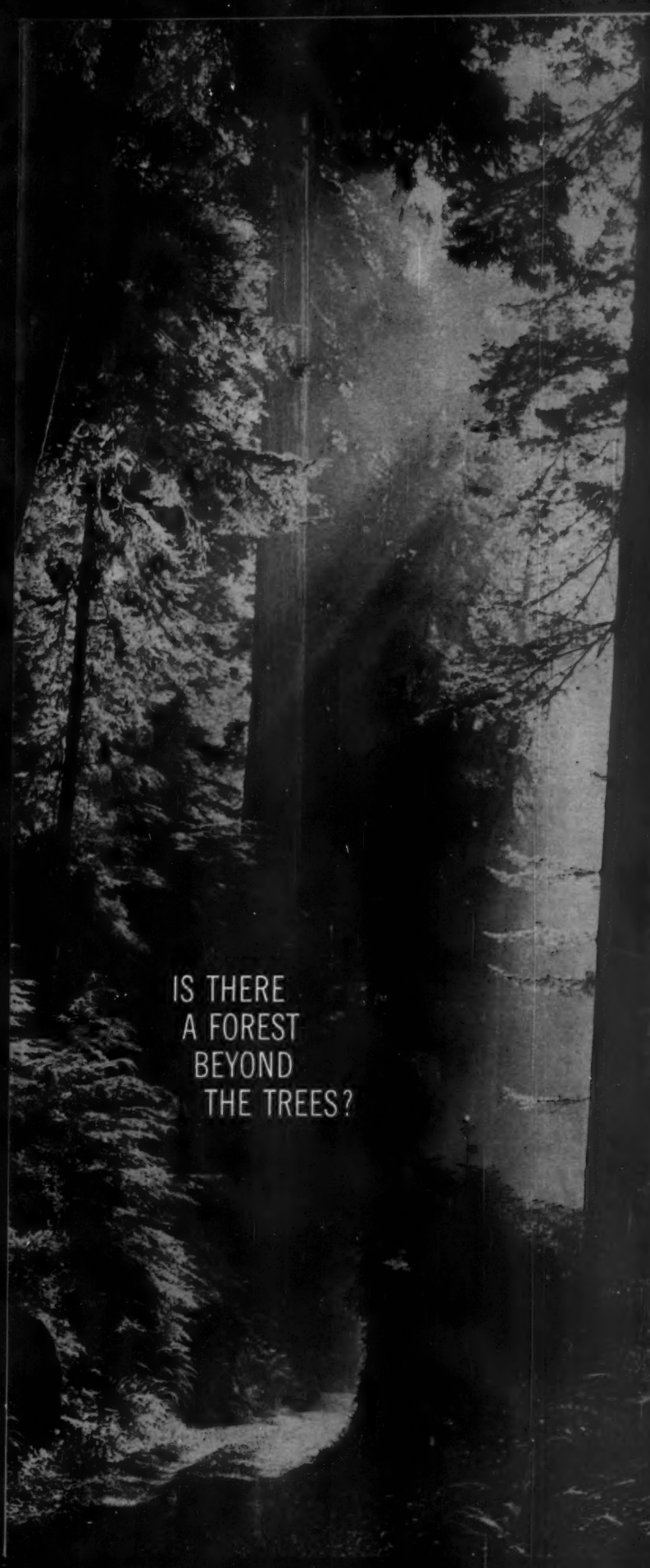
In the first experiment, neither of the machines was given any "negative training." That is, during the training period, the machine's A-units received only a "reward signal" when it correctly identified the proper shaped target; no "punishment" signal was given the A-units when it made an incorrect identification.

In the next experiment, a small amount of negative training was given the machine on some of the non-target shapes but only sketchy negative training on other non-targets, according to Murray. When the first experiments were repeated, the beneficial effect of the negative training was apparent in the reduced false-alarm rate.

However, another mode of operation was devised which gave an even more substantial reduction in the false-alarm rate. This mode is called the "four-fix look" mode. It has its human analogy in that people often take several looks at an object in a photograph before they are able to decide what it is, or is not.

In normal operation, as soon as the stimulus image is exposed to the Perceptron's retina, the machine is commanded to respond. But in the four-fix look mode, the retina is exposed to the image, then the image is shifted one retina photocell to the right, then one down and finally one to the left. Only after the machine is given these four looks is it commanded to respond and its ultimate response is calculated from the average of the net signal voltages delivered to the response unit (R-unit) from each image position. (For detailed description of Perceptron operation, see AW July 4, p. 72.)

A comparison of the value of negative-training and four-fix looks on target identification in CAL's tests showed the following. The use of four-fix looks, without any negative training, slashed the false-alarm rate of the X-trained



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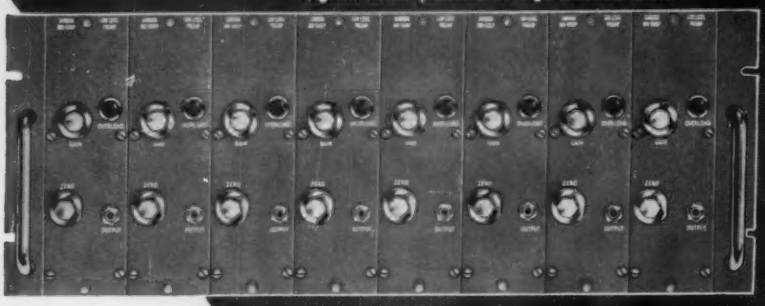
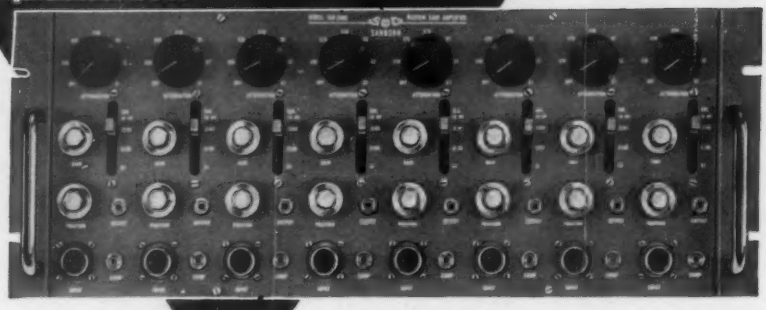


Model 658-3400— drives high frequency optical galvanometers to 5 KC



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Noise	3 uv peak-to-peak
Gain	100 (10 mv in gives 1 v out) (Model 860-1500PA with gain of 1000 also available)
Output	± 1 v across 300 ohms, DC-70 cps; ± 1.5 v to 40 cps. Output impedance 100 ohms. (10 v across 10K available on special order.)
Linearity	± 0.1% of full scale output (2 v)
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Input Impedance	Greater than 200,000 ohms
Gain Stability	± 0.1% for 24 hours
Drift	± 2 uv referred to input
Rise Time	to 99.9% less than 25 ms

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Eight channels of amplification and common power supply. Each channel provides for sensitivity, compensation, damping and current limiting. Inputs floating and guarded, impedance 100,000 ohms on all ranges. All amplifier elements except output transistors are plug-in assemblies.

Sensitivity	± 10 mv input gives ± 400 ma output into 20 ohm load (max.). Eleven attenuator steps to X2000 in 1-2-5 ratio, smooth gain control.
Common Mode Performance	± 500 volts, max; rejection 140 db min at DC.
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(NO NEGATIVE TRAINING)

		STIMULI						DETECTION RATE	FALSE ALARM RATE
		X	O	□	△	DOTS	LINES		
PERCEPTRON TRAINED POS. ON X	1-FIX	12/12	1/12	5/12	4/12	3/12	3/12	1.0	0.27
	4-FIX	6/6	0/6	0/6	1/6	0/6	0/6	1.0	0.03
PERCEPTRON TRAINED POS. ON O	1-FIX	3/12	12/12	12/12	4/12	5/12	4/12	1.0	0.47
	4-FIX	1/6	4/6	4/6	5/6	0/6	0/6	.7	0.33

FREQUENCY OF "TARGET" RESPONSES

(SOME NEGATIVE TRAINING)

		STIMULI						DETECTION RATE	FALSE ALARM RATE
		X	O	□	△	DOTS	LINES		
PERCEPTRON TRAINED POS. ON X	1-FIX	11/12	0/6	6/12	3/12	5/12	1/12	0.9	0.25
	4-FIX	6/6	0/6	0/6	0/6	0/6	0/6	1.0	0
PERCEPTRON TRAINED POS. ON O	1-FIX	0/6	9/12	4/12	3/12	1/12	4/12	0.8	0.20
	4-FIX	0/6	6/6	3/6	3/6	0/6	0/6	1.0	0.20

FREQUENCY OF "TARGET" RESPONSES

TO REDUCE false alarm rate, two techniques were successfully used. Negative training, in which machine is exposed to both wanted and unwanted shapes during training and "four-fix" in which machine gets four looks at image, each with image at a slightly different location on the retina. Latter, which has human analogy, was more successful.

machine in these tests from 27% to only 3%, without any deterioration of its 100% abaility to spot "X's." When combined with negative training, the X-trained machine continued to identify "X's" every time, and its false alarm rate dropped to zero.

The value of four-fix looks for the machine trained to identify circles was not quite so effective. With no negative training, the additional looks enabled the machine to reduce its false-alarm rate from 47% to 33%, but in so doing the machine's ability to identify circles dropped from 100% to 70%. With the combination of four-fix looks and negative training, the machine returned to 100% identification of circles with a still lower false-alarm rate of 20%.

Additional experiments conducted using pairs of shapes, one superimposed upon the other, tended to confirm the merit of multi-look over single-look exposure but showed mixed results for negative training. However, subsequent experiments indicated that the results of negative training might have been more favorable if a more extensive period of training had been used, according to Murray.

In another series of experiments, CAL used target shapes which more closely resemble those which a machine might be expected to detect. It was not feasible to expose the Perceptron directly to reconnaissance photographs because of the limitation inherent in the Mark I which originally was built only to demonstrate the principle of self-learning machines. The Mark I's retina has only 400 photo-cells and is designed to give only a "black" or "white" response, with no gray-scale shading.

For this reason, simple black-and-white sketches shaped like aircraft and ships were used in these experiments. In one trial, the Perceptron was exposed to four different images: an airplane, an airplane in a revetment, a revetment of the same shape without an aircraft, and a shed-trench complex. The machine was exposed to each sketch 12 times after having been given positive training for the revetment with aircraft image, and a small amount of negative training for the revetment without aircraft.

Example of Accuracy

In the experiments the machine correctly identified the aircraft in the revetment 92% of the time, falsely identified the aircraft alone 6% of the time, but was never misled by the revetment alone or the shed-trench complex.

In a similar experiment, intended to test ability to detect targets in the presence of clutter, a target shaped like the plan view of a ship was used. The machine was trained on the target image alone, but in subsequent tests was asked to spot the target when superimposed on a random clutter of dots or a random clutter of lines.

The Perceptron correctly spotted the target image 83% of the time when it was superimposed on either dot or line clutter. When the machine was exposed only to line clutter with no target present, it false-alarmed in 25% of the exposures, thinking that it saw a ship in the clutter. It had no such difficulty with the dot clutter, giving an over-all false-alarm rate of 12% for both types of clutter.

Cornell Aeronautical Laboratory scientists call the results of these, and other photo-intelligence experiments, "encouraging." These experiments have demonstrated considerable photo-interpretation ability inherent even in so small and simple a machine as the Mark I, they conclude. Laboratory and ONR-financed design studies for a Mark II Perceptron, with approximately 20 times as many A-units and nine times as many photo-cells in its retina, indicate it should be able to handle much more difficult photo-interpretation tasks.

Batteries Tested For Space Reliability

In first life-cycle tests on nickel-cadmium batteries at new Air Force-sponsored test facility in Dayton, approximately 25% of the cells failed after a total of 575 charge/discharge cycles, each consisting of 55 min. under charge followed by 35 min. under discharge. Remainder of the cells will be operated for a total of 6,000 cycles or until all have failed, whichever occurs earlier.

Tests were conducted by the Dayton-Inland Testing Laboratories of

NICKEL-CADMIUM BATTERIES undergoing high-temperature life-cycle (charge/discharge) tests at new Dayton-Inland Laboratories under Air Force sponsorship to determine their reliability for space vehicle use and basic causes of battery failures.

NEW DORSETT "20" SERIES

provides maximum telemetry system flexibility!

- Requires Less Power
- Meets Most Rugged Environmental Conditions
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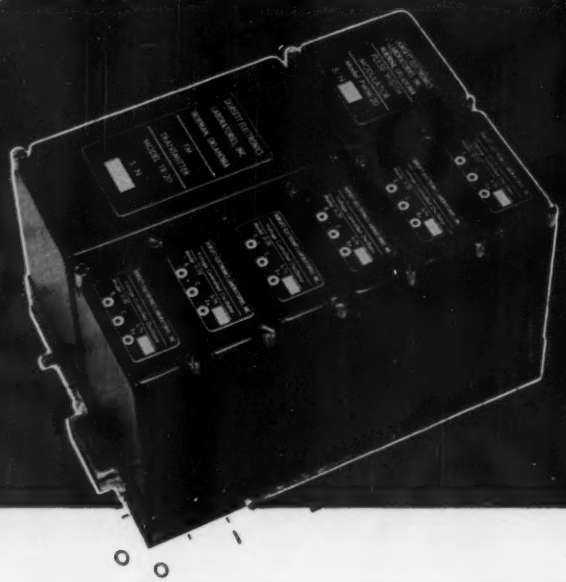


SOLID STATE COMPONENTS AVAILABLE FOR "20" SERIES PACKAGING

- TR-20 2-watt FM Transmitter, 225 - 260 mc.
- TR-21 2-watt FM Transmitter, 136 - 137 mc.
- O-20A Subcarrier Oscillator
- MVO-20 Millivolt Subcarrier Oscillator
- ACA-20 Low Level AC Amplifier
- DCA-20 Low Level DC Amplifier
- PWM-20 Pulse Width Modulator
- PS-20 Regulated Power Supply

MODULAR PACKAGING DESIGN of the new "20" series line of telemetering components and systems lets you put more telemetering equipment in less space. Every system component has been packaged in compatible modules identical in height (2.25") and width (1.875"), with thicknesses of one, two, or four units (.875" per unit). These standard modules permit a wide range of system configurations, and make future modification of basic systems easy and economical.

EVERY "20" SERIES COMPONENT utilizes silicon semi-conductor circuitry—no tubes anywhere. The typical "20" series 12 channel system including transmitter, weighs less than 5 pounds, draws less than 20 watts from a 28 volt supply, and exceeds military specifications for reliability and performance throughout extreme missile environments.

FOR YOUR NEXT TELEMETERING REQUIREMENT let Dorsett take the problems out of system packaging with a "20" series telemetry system. Your inquiries or specifications will receive a prompt reply.

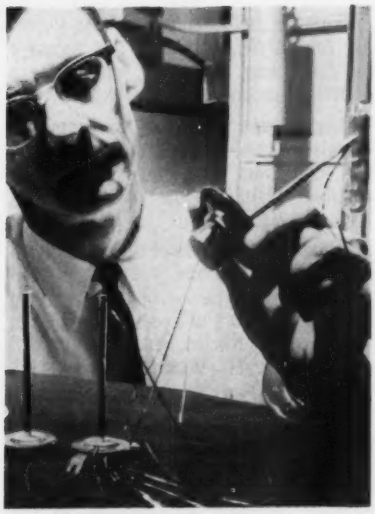
DORSETT ELECTRONICS, INC.

P. O. Box 862, Norman, Oklahoma, Ph: JEfferson 4-3750

Cook Electric Co., a facility recently established to serve as an independent test organization for evaluating batteries used in space and missile applications (AW Oct. 17, p. 63).

A total of 80 nickel-cadmium cells of the sealed starved-electrolyte type used in the tests were divided into eight sample groups, each consisting of 10 cells. Four of the test groups were operated at room temperature, each under a different charge/discharge cycle, while the remaining four groups were tested under identical charge/discharge conditions but at an elevated temperature of 120F. The results were:

- **Shallow discharge** (100% charge to 75% charge): There were no failures at room or elevated temperature.
- **Medium discharge** (100% charge to 50% charge): Four failures occurred, one at room temperature and three at 120F. Average time of failures was after 500 operational hours.
- **Deep discharge** (100% charge to 25% charge): Ten of the 20 cells under test failed; half of them were cells operating at room temperature and half at 120F. The cells tested at room temperature had average life of 450 operational hours before failure while those that failed at 120F had average life of 345 hr.
- **Mid-capacity/deep discharge** (80% charge to 20% charge): Three of 10 cells operated at room temperature failed after average of 541 operating



Vapor Thermionic Converter

Vapor thermionic converter which delivers 10 watts power and operates at 11% efficiency at cathode temperature of 1,300C, has been operated for 168 hr. continuously by General Electric's Power Tube Dept. in Schenectady, N. Y. Tube also has undergone 20 room-temperature-to-1,300C-temperature cycles to test its hermetic seal.

For Flight Test Indication of Temperature, Acceleration, Pressure, Stress and Flow

Autopot is a highly versatile flight test instrument. Modular plug-in construction permits simple conversion for millivolt or thermocouple use. Unique servo design makes operation completely automatic. Single power source requires no battery or standard cells. Quick-change range card and dial face kits extend operating range. Meter size conforms to mil specs for control panel mounting.

Request Bulletin 682 for complete data.

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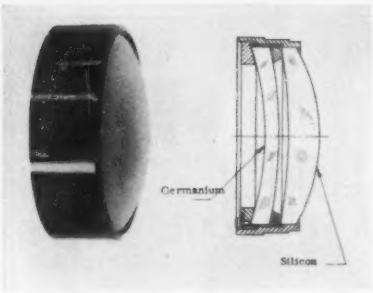
A leader in development and manufacture of gyroscopes and airborne instruments.



Achromat Infrared Lens

Achromat infrared lenses, covering the 8 to 14 micron wavelength, are now in production at Servo Corp. of America, supplementing previously available lenses which covered 1 to 6 micron band.

hours, while two of the cells that failed at 120F had average life of 760 hr.

Original plans to test an additional 80 nickel-cadmium batteries at low temperatures of zero and −30F were shelved after preliminary tests indicated cells could not withstand long cycling tests at these temperatures.

Cells that failed under test have been returned to their manufacturer for post mortem examination. The Cook Electric facility, operating under Wright Air Development Division sponsorship, plans future tests on silver-zinc and silver-cadmium cells, company reports.

Waveguide Filters Cut Harmonic Interference

New York—Waveguide power filters which effectively eliminate radio frequency interference caused by harmonics have been introduced by General Electric Co. Seven models are available for high-power microwave transmitters with fundamental frequencies of from 400 to 6,000 mc.

The filters work on a principle similar to that of an automobile muffler. Hundreds of coupling slots and associated secondary waveguides leak away harmonic signals but still allow the fundamental frequency to pass through with undiminished power. Absorbers dispose of the unwanted energy.

To guard against waveguide arcing caused by harmonics and to improve the power-handling capacity of the system, the filter is connected as closely as possible to the output tube. It is then connected to other components in the system such as a waveguide switch, a duplexer if only one antenna is used, a rotary joint if a mechanically movable antenna is used, and the antenna itself.

The seven filters cover the S-, C-, L-, and UHF bands; range from 50 to 1,200 lb.; and cost from $2,000 to $12,000. GE foresees no basic difficulty in retrofitting into existing systems.

FILTER CENTER

▶ **Personnel Recruiting Drops**—Survey of employment trends for electronic executives, scientists and engineers indicates that hiring will be down 30% from 1960. Only 20% of 385 electronic companies surveyed by Davies-Shea, Inc., electronics personnel consultant firm in Chicago, said they planned to increase their hiring rate. Another 15% of the companies forecast no change, while remaining 65% said they planned to reduce hiring by from 10 to 85%.

▶ **Federal Telecommunications System Planned**—Government has announced plans for a unified telecommunications system for all civilian agencies, to be known as the Federal Telecommunications System (FTS). System, to be administered by the General Services Administration, will be implemented in stages over three-year period to increase capability for direct long-distance dialing. Another objective is multi-channel routing with switching centers located away from strategic target areas to permit messages to bypass such areas. The

Ionization Gage

Ionization gage, developed by Westinghouse Electric, permits direct measurement of pressures and densities at altitudes ranging from 70 to 125 mi., and can be built for operation up to 450 mi. Device is self-contained version of Bayard-Alpert ionization gage, consisting of triode in which electrons from hot cathode ionize gas molecules that have entered through open port. Positively charged ions are propelled to negatively charged collector, producing direct current which is proportional to molecular density. Gage measures 1 in. in dia. and is 3½ in. long.

PROJECT NERV

From the first Nuclear Emulsion Recovery Vehicle (NERV) launch and recovery on September 19, 1960, came these important accomplishments:

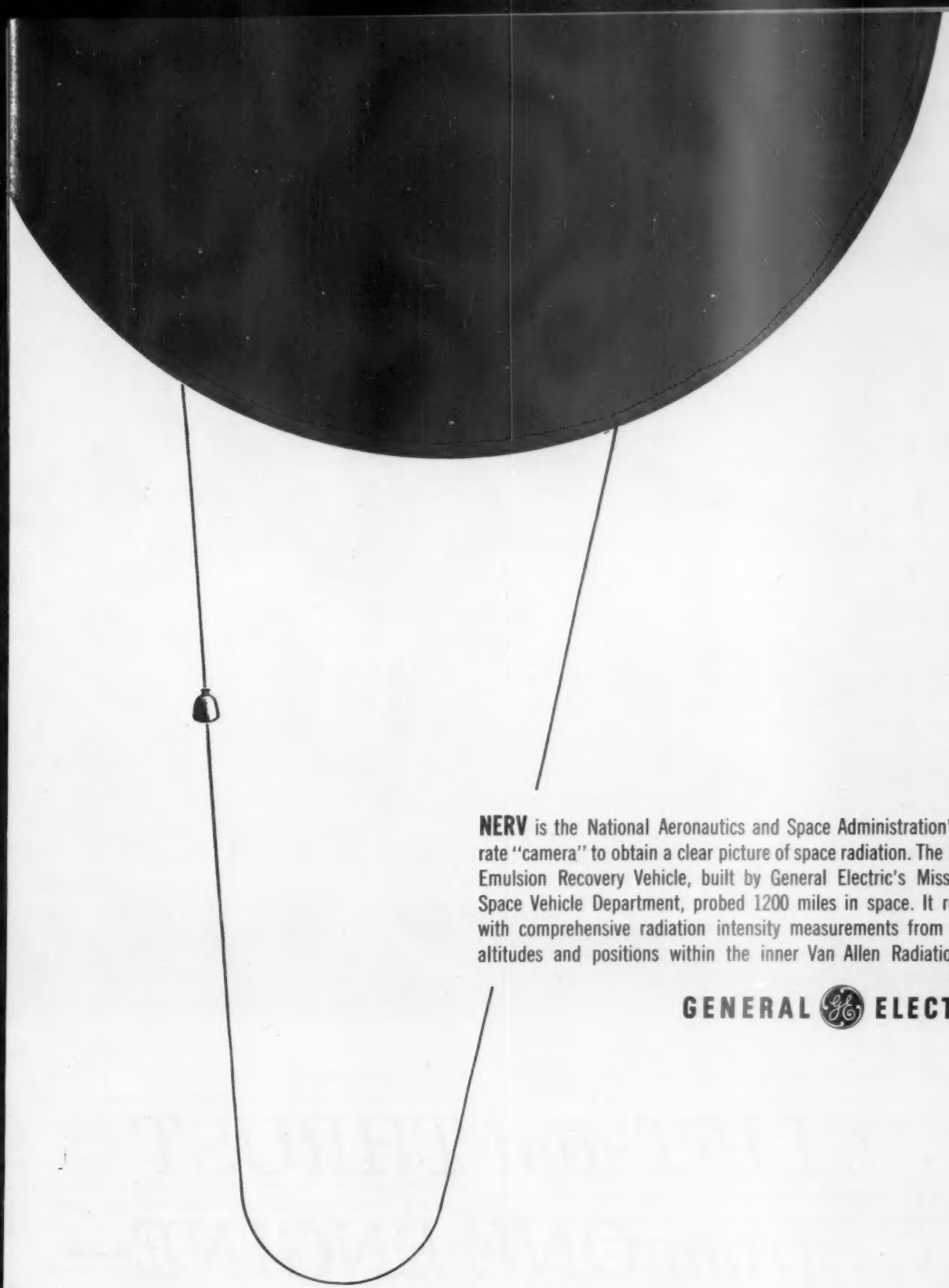
Highest Space Probe of a Recovered Vehicle—The 83.6 lb NERV (19″ wide and 17″ long) was recovered after a 1200 mile-high flight into the inner Van Allen Radiation Belt.

Detailed Measurements of Space Radiation A disc, 1/2″ thick and 3″ wide, extended from the vehicle during flight, exposing a stack of 25 layers of special emulsion to the radiation particles. Recovery permitted scientists to analyze the emulsion directly.

First Re-entry of a Vehicle with a Discontinuous Surface—The NERV ablation nose cone, intentionally discontinuous to permit exposure of the payload, was the first "broken" surface to survive the intense heat of re-entry. Performance of the vehicle was successful in all respects.

General Electric's Missile and Space Vehicle Department designed and built NERV for National Aeronautics and Space Administration's Goddard Space Flight Center. MSVD is a department of the G.E. Defense Electronics Division. 163-04

GENERAL ELECTRIC



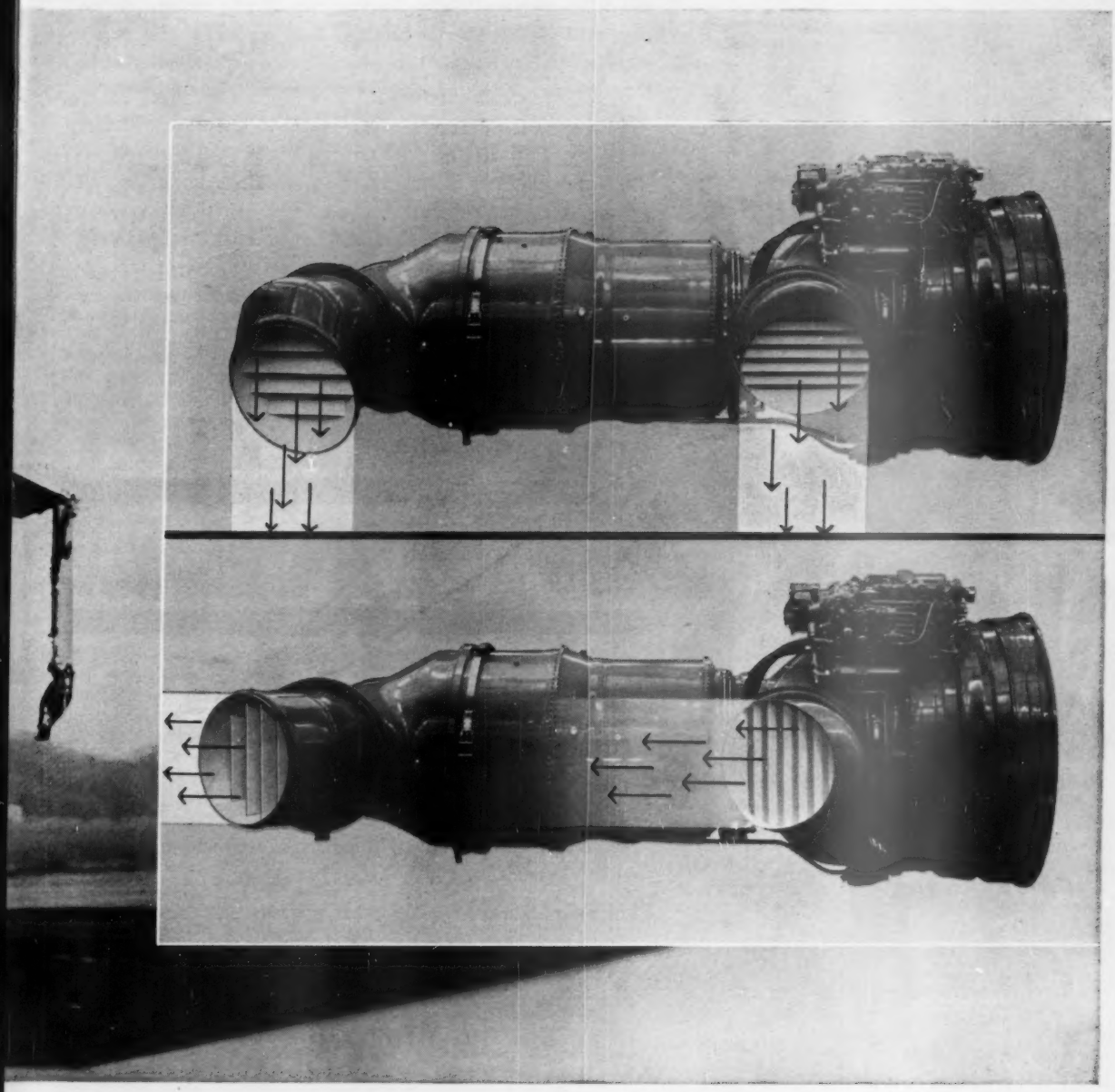
NERV is the National Aeronautics and Space Administration's accurate "camera" to obtain a clear picture of space radiation. The Nuclear Emulsion Recovery Vehicle, built by General Electric's Missile and Space Vehicle Department, probed 1200 miles in space. It returned with comprehensive radiation intensity measurements from various altitudes and positions within the inner Van Allen Radiation Belt.

GENERAL ELECTRIC

MISSILE AND SPACE VEHICLE DEPARTMENT, PHILADELPHIA, PA.

LIFT and THRUST from ONE ENGINE—

the revolutionary BS 53 turbofan



The new Bristol Siddeley BS 53 high-ratio turbofan represents a major engineering breakthrough in the field of aircraft propulsion.

Because the BS 53 can be fitted with movable nozzles evenly disposed around the centre of gravity which give directional control to its total thrust, this remarkably versatile engine provides the airframe designer with *a single power source for all conditions of flight*

VTOL, STOL and normal take-off capability in the same aircraft. Suitable for subsonic or supersonic applications.

High cold-flow ratio gives high thrust for low weight, low fuel consumption and low noise level.

Conventional installation. Operational simplicity. Independent of all fixed ground installations.

Problems of ground erosion, recirculation and ingestion of debris reduced to a minimum.

The Bristol Siddeley BS 53 has already been selected for, and is now undergoing trials in the Hawker P 1127 VTOL light strike fighter and is supported by the Mutual Weapons Development Programme for NATO.

For further information please write to: Bristol Aero-Industries Limited, 10210 Pie IX Boulevard, Montreal North, PQ, Canada.

BRISTOL SIDDELEY ENGINES LIMITED TURBOJETS—TURBOFANS—TURBOPROPS—RAMJETS—ROCKET ENGINES—MARINE AND INDUSTRIAL GAS TURBINES—MARINE, RAIL AND INDUSTRIAL DIESEL ENGINES—PISTON ENGINES—PRECISION ENGINEERING PRODUCTS.

Acoustical noise: 85 db. at 6 inch distance

For noise at microwave frequencies, too, there's an ideal device in a small package. It's the Litton L-2000 series of miniature gas discharge noise sources. Use them for automatic monitoring of the performance and sensitivity of modern radar systems. They're available to cover the most-used frequency bands and come in a variety of mount configurations.

The series features a shielded cathode, low modulator drain, and field-replaceable tube insert. Rugged. Insensitive to a wide range of ambient temperatures. Compactly engineered for demanding air and ground environments. Economical because of replaceability, plus added advantages of logistic simplicity and ease of maintenance.

BIG NOISE FROM A SMALL SOURCE

The tube pictured here is the single-ended L-2000 with the LR-2000 insert, specified for a recent generation of FAA airport surveillance radars and for a variety of well-known "S-band" military systems.

For more data on these or other precision gas tube products, write Litton Industries, Electron Tube Division, 960 Industrial Road, San Carlos, California. Or telephone LYtell 1-8411.

GAS NOISE TUBES

Type Number	Frequency Range (megacycles)	Excess Noise Ratio (db)	Nominal Operating Current (ma)	Nominal Operating Voltage (volts)	RF Coupling
L-2008	200-250	18.5 ± 0.5	25	200	¾" coax*
L-2013	570-630	18.5 ± 0.5	25	200	¾" coax*
L-2006	1200-1400	18.5 ± 0.5	50	175	¾" coax**
L-2000(R)	2700-2900	18.5 ± 0.2	75	30	RG-48/U WG*
L-2018(R)	2700-2900	15.5 ± 0.2	75	35	RG-48/U WG*
L-2011(R)	3300-3700	18.4 ± 0.2	150	30	RG-48/U WG*
L-2009(R)	3400-3700	15.5 ± 0.5	125	20	RG-48/U WG*
L-2007	2000-4000	18.5 ± 0.5	85	135	¾" coax**
L-2010	2000-4000	15.0 ± 0.5	40	60	¾" coax**
L-2001(R)	5400-5900	13.0 ± 0.5	100	55	RG-49/U WG**
L-2002(R)	7500-8600	14.5 ± 0.5	100	40	RG-51/U WG**
L-2003(R)	8500-9600	14.5 ± 0.5	100	45	RG-52/U WG**
L-2004(R)	8500-9600	18.5 ± 0.5	100	45	RG-52/U WG*
L-2017(R)	8970-9190	18.5 ± 0.5	100	45	RG-52/U WG*
L-2005	16000-17000	18.5 ± 0.5	55	55	RG-91/U WG*

(R) denotes replaceable gas tube insert
*single ended mount
**double ended mount

LITTON INDUSTRIES
Electron Tube Division
MICROWAVE TUBES AND DISPLAY DEVICES

FTS will connect some 8,000 government offices in 1,750 cities in the U. S., Puerto Rico and Virgin Islands.

▶ **British Seek U. S. Avionics Business**—British Marconi's Wireless Telegraph Co., a major producer of airline avionics equipment, has signed long-term exclusive agreement with Wilcox Electric Co., Kansas City avionics manufacturer, to pool technical resources in avionics equipment. Under the agreement, Wilcox will market Marconi's avionics equipment in the U. S. as well as working with the British firm on research and development programs.

▶ **Semiconductor Industry Survey**—U. S. semiconductor manufacturers spent more than $70 million in 1959 for research and development, of which $16 million (23%) was funded directly by the government, primarily the Defense Department, according to survey reported by Commerce Department's Business and Defense Services Administration. Survey of 60 companies disclosed that three firms accounted for 39% of the total factory shipments in 1959, the latest year for which data is available. Companies employed a total of 34,700 production workers as of April, 1960, approximately 6,200 engineers and scientists and 7,800 other workers. Results of the BDSA survey, entitled "Semiconductors: U. S. Production and Trade" is available from Supt. of Documents, Government Printing Office, Washington 25, D. C. or any Commerce Dept. Field Office for 15¢.

▶ **Radar Targets Identified by Ear**—Experiments indicate that trained radar operators can effectively discriminate between single and twin-engine turbojet aircraft and between single and dual targets, as well as detecting changes in target velocity and direction when the modulation of radar echos is presented aurally to the operators. Using aural presentations, trained operators could discriminate between single and twin-engine aircraft with probability of 73%, between one and two aircraft with probability of 76%, could detect change of target velocity with probability of 97% and a 180-deg. turn 100% of the time, according to report presented by Richard W. Pew of the University of Michigan and Jerome I. Elkind of Bolt Beranek & Newman, Inc., Cambridge, Mass. Problem of training radar operators to use aural presentation is similar to that of training sonar operators, according to the authors.

Machine Records, Retrieves Magazine Pages

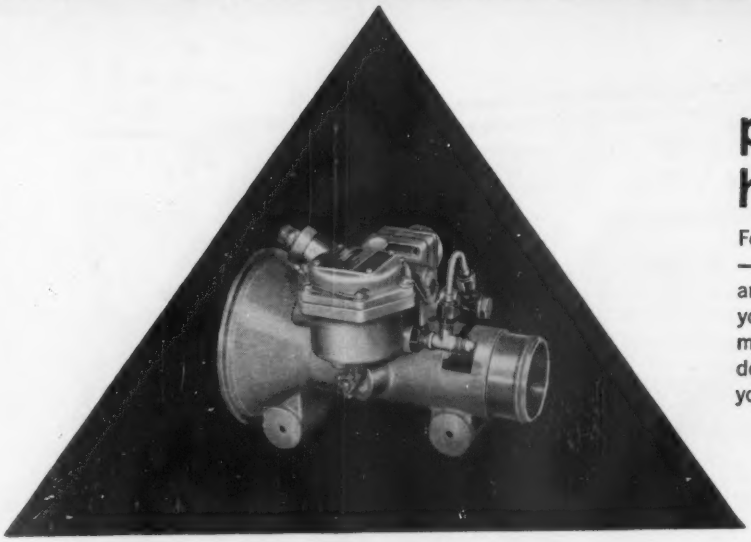
FileSearch, new machine which can store 32,000 standard-size magazine pages on a single reel of microfilm and subsequently, upon request, search for stored information at the rate of 6,400 pages per minute. When desired page is located it is displayed on screen (center). A hard copy can be produced, if desired. Search request is initiated by means of a punched card. First system is scheduled to be delivered to Navy Bureau of Ships in Washington soon. System, produced by FMA Inc., El Segundo, Calif., is priced at slightly over $100,000 which includes both recording and retrieval functions.

NASA Computer Claimed to Be World's Largest

Giant analog computer for National Aeronautics and Space Administration, Langley Field, is called world's largest by manufacturer: Electronic Associates Inc. Computer, built under a $1.5 million contract, contains 1,500 high-speed computing units and three automatic digital input-output systems which permit computer to be set up from prepared punched paper tape or by manual keyboard. Three of the five computing systems included in the computer operate at speeds up to 50 solutions per second for repetitive operations.

Services Fund Optical Maser Studies—Several studies involving applications of optical masers are being funded by the armed services. American Optical Co. recently won an award from Wright Air Development Division for a sun-powered optical maser communications transmitter (AW Dec. 5, p. 92) and Technical Research Group, Inc., will study modulation techniques for optical masers under another WADD contract. Army's Frankfort Arsenal presently is evaluating proposals for a 10,000-yd. range finder for helicopters and tanks which may use an optical maser.

▶ **Infrared Semiconductor Bolometer**—Liquid-helium cooled germanium bolometer which shows promise of being a highly sensitive IR detector even in the far infrared where such devices are now needed is under development



pneumatic & hydraulic controls

For cryogenic or high temperature applications —or anything between—Janitrol can design and manufacture the valve, regulator or control you need. Janitrol engineers regularly design multiple function air and liquid controls to demanding performance specs. How tough is yours? Request engineering data sheets.

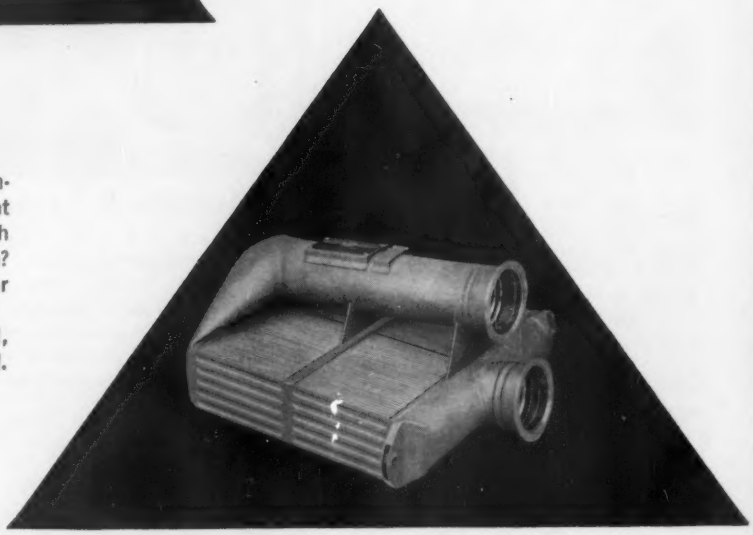
heat exchangers

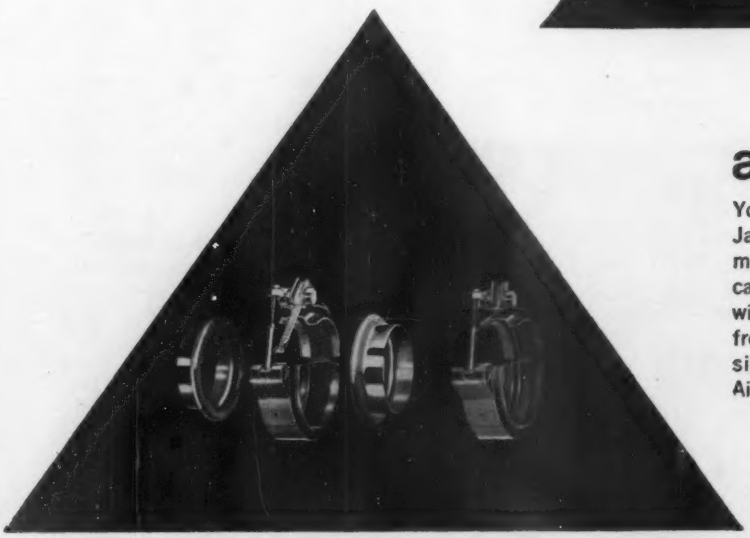
Janitrol is experienced in the design and manufacture of stainless steel and aluminum heat exchangers and heat transfer systems. Which technique can we put to work on your problem?

Types: tube & shell, plate & fin, platular modules, tubular modules, combinations.

Fluid combinations: air/air, air/liquid, fuel/oil, fuel/boiling liquid, air/boiling liquid.

Request Bulletin JA-141.





air duct couplings

You should look into the broad standard line of Janitrol air duct couplings that provide maximum safety through metal-to-metal seal. You can connect and disconnect them repeatedly without performance sacrifice. Standard sizes from 1" to 7"; special couplings can be designed. Request engineering data. Janitrol Aircraft, 4200 Surface Rd., Columbus 4, Ohio.

JANITROL

A division of Midland-Ross Corporation M-R

pneumatic controls • duct couplings and supports • heat exchangers • combustion equipment for aircraft, missiles, ground support

Mylar Space Antennas

Unfoldable and inflatable antennas made of Mylar film and aluminum foil reinforced with Mylar, under investigation by Lockheed Missiles and Space Div. for possible space vehicle use, include six-foot sphere (left background) for directional communications, a conical spiral (center) wide-band antenna, and an array of spiral elements (right) providing a fan beam. Parabolic reflector shown extreme right is made up of segmented metal petals which can be unfolded after vehicle is in orbit.

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at Texas Instruments' Central Research Laboratories. While sensitivity and time constant of a bolometer can be traded off for one another, a typical sensitivity for this bolometer reportedly is 10^{-10} watts/cm.^{2} The device need not be coated for wavelengths up to 1.5 microns.

▶ **Alternate Minuteman Component Source**—Autonetics, associate prime contractor for the Minuteman guidance system, is evaluating 27 companies which are competing to become second source for circuit boards for the Minuteman guidance program. An award to one of these may be made in May.

▶ **Polaris Submarine Star Trackers**—Proposals for all-weather star trackers which can correct long-term errors accumulated from gyro drift in the inertial navigation systems of Polaris submarines are being evaluated by Sperry Marine. Trackers would take periodic fixes on the sun or moon, feed this data to the submarines' computers for calculation of ship's actual position. Among the companies bidding for the contract are Kearfott and Nortronics Precision Products Department which made one star tracker for a Polaris submarine last year (AW Feb. 29, 1960, p. 81).

▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

• **The American Optical Co.,** Southbridge, Mass., $71,587 contract for study of optical fiber techniques for data processing equipment, from Rome Air Development Center.

• **Interstate Electronics Corp.,** Anaheim, Calif., $9.5-million letter of intent from Navy for design and manufacture of nine test instrumentation systems for new 616-Class Polaris submarine. Each system will include telemetry, timing and control, communications, checkout, environmental analog recording and digital recording.

• **General Telephone & Electronics,** $1.5-million award from Rome Air Development Center for ground countermeasures receiving equipment which will be part of USAF's Electromagnetic Intelligence System (466-L). Company's Electronic Defense Laboratories, Mountain View, Calif., also received $4-million Army contract for research and development in electronic warfare techniques.

• **Ryan Electronics,** a division of Ryan Aeronautical Co., San Diego, $280,000 for spares for AN/APN-129(V) doppler navigation set from Army Signal Supply Agency.

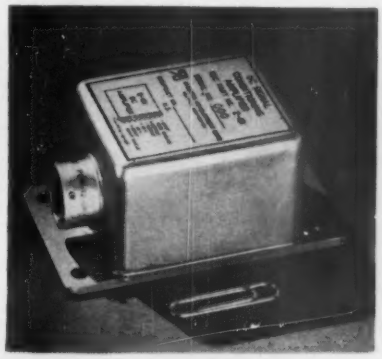
• **Bendix Corp.,** Teterboro, N. J., $23 million for added production of B-58 flight control systems from Convair Division of General Dynamics; also $4.3 million for production conversions of early B-58 control systems to tactical configuration.

• **Remington Rand Univac,** St. Paul, Minn., $5.5-million Navy contract for production of additional AN/USQ-20V computer systems for Naval Tactical Data Systems (NTDS).

NEW AVIONIC PRODUCTS

• **Thin film tester,** Type 2104, a high-speed programable pulse generator capable of rapidly analyzing, testing and programing thin-film and cryogenic devices. Generators run at clock frequencies higher than 4 mc., at levels having 25 nanosecond rise times and 50 nanosecond widths. Manufacturer: Digital Equipment Corp., Maynard, Mass.

• **Signal conditioning amplifier,** Model 2-181, weighs less than ½ lb. and has over-all length (as shown in photograph) of 3½ in. Unit, designed to amplify low-level outputs from strain gages and thermocouples in ballistic missile environments, is entirely transistorized; contains a d.c.-to-d.c. converter to isolate signal circuits from power circuits. Package operates from 28-v. supply, has less than 20 mv. noise peak to peak and gain variable from 75 to 150. Manufacturer: Electro Development Corp., 3939 University Way, Seattle 5, Wash.



• **Static converter,** Model SMC-1000-UX, produces output signal (voltage or current) directly proportional to input frequency or pulse rate with accuracies of ±½% of full scale with less than 100 ppm/deg. C. temperature sensitivity. Full scale outputs range to 10 v. with load variations of 1,000 to 1 megohm. Models capable of providing higher power and voltage can be made on request. Manufacturer: Pioneer Magnetics Inc., 850 Pico Blvd., Santa Monica, Calif.

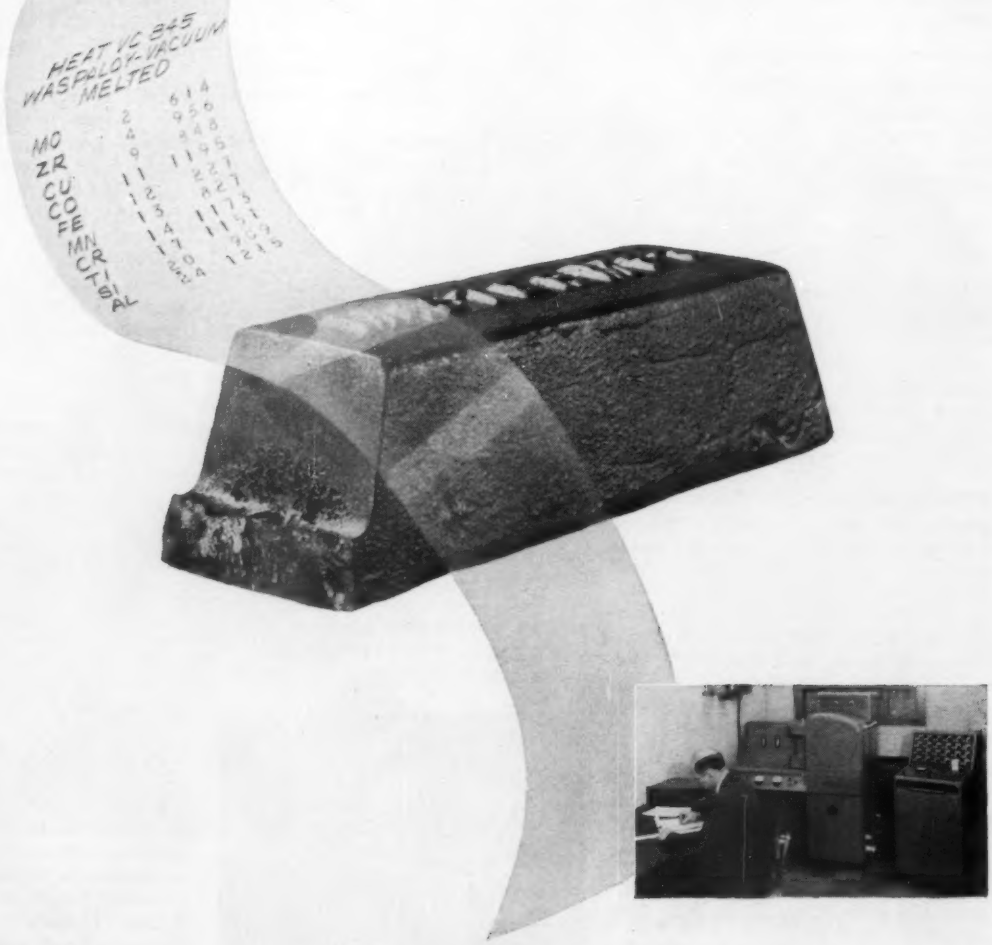
• **Micro semiconductor devices,** a line of rectifiers and diodes, are being made available in unencapsulated surface-passivated packages measuring 75 x 30 mils maximum. Line includes silicon rectifiers with peak inverse voltage ratings up to 1,000 v., computer diodes with 2 nanosecond recovery times and 2 picofarads capacitance, general-purpose silicon diodes and fast recovery diodes. Manufacturer: MicroSemiconductor Corp., 11250 Playa Court, Culver City, Calif.

• **Variable attenuator,** Model X2217, can maintain 30 db. of attenuation over a frequency range of 10,250 to 10,500 mc., can be switched from minimum to maximum attenuation in less than 20 microseconds. Similar models for other frequency ranges are available. Manufacturer: Cascade Research, 5245 San Fernando Road, Los Angeles 39, Calif.

• **Miniature transformers** for use in transistor circuits, epoxy encased in drawn steel cans for use in high-density

NEW 15-MINUTE X-RAY OF AN ALLOY MEANS STILL HIGHER QUALITY...

STILL FASTER SERVICE FROM C-M. HERE'S THE RESULT OF A GREAT NEW ADVANCE IN QUALITY CONTROL — A COMPLETE ALLOY ANALYSIS ON PRINTED TAPE OBTAINED WITH THE UNIQUE NEW X-RAY SPECTROGRAPHIC PROCESS. THIS NEW METHOD BENEFITS YOU TWO IMPORTANT WAYS: FIRST, IT MAKES ALLOY ANALYSIS MORE ACCURATE THAN EVER BEFORE . . . WHICH MEANS ADDED CERTAINTY THAT YOUR ALLOYS ADHERE RIGIDLY TO QUALITY SPECIFICATIONS. ALSO, THIS NEW X-RAY PROCESS MAKES THE COMPLETE ANALYSIS IN JUST 15 MINUTES INSTEAD OF 3 DAYS. TOTAL RESULT: STILL HIGHER QUALITY, BETTER SERVICE, FASTER DELIVERY. A POST CARD BRINGS FULL INFORMATION.



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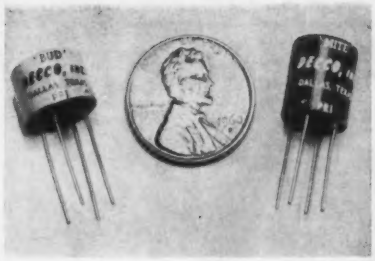

component packaging, are available in selection of primary/secondary impedance ranges, power ratings. One type, limited to $\frac{5}{16}$ in. high, is suitable for mounting on substrate where substrates are stacked compactly on top of one another. Another $\frac{3}{8}$-in.-dia. unit may be employed for effective use of space on chassis. Manufacturer: Decco, Inc., 2025 Farrington, Dallas 7, Tex.

• **Frame-grid subminiature tubes,** CK 7994 and CK 7995, similar to larger model frame grid tubes, will permit tight packaging of electronic gear. Both tubes have low feedback capacitance between plate and cathode plus heater, high transconductance-to-plate current ratio, low noise and low inter-electrode capacitance. The CK 7994 is a high-frequency grounded-grid triode; the CK 7995 is designed for use as a wide-band RF or IF amplifier. Manufacturer: Raytheon Co., Industrial Components Division, 55 Chapel St., Newton 58, Mass.

• **Transistorized servo amplifier,** Model 1035, which weighs 1 oz. and occupies one cubic inch, can drive a 40-volt, two-phase servomotor up to 3½ watts input. Amplifier employs silicon transistors, operates at 400 cps. over the temperature range from −55C to 125C and is available in simplified clip, stud or servo mounting. Priced at $190 to $200 in sample quantities, the amplifier can be obtained on a 30-day delivery basis. Manufacturer: Melcor Electronics Corp., 48 Toledo St., So. Farmingdale, N. Y.

Could a Rider be Lost? The new U.S. Defense position, calling for an end to "Nickel & Dime economy," is almost certain to obtain widespread approval within our missile industry.

With manned space vehicles a practical reality, it is safe to assume that U.S. Public Opinion would never tolerate the loss of a rider for want of the best possible nail.

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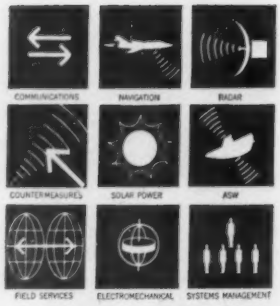

Hoffman / **ELECTRONICS CORPORATION**

Military Products Division

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SIGNIFICANT DEVELOPMENTS AT HOFFMAN HAVE CREATED POSITIONS FOR SCIENTISTS AND ENGINEERS OF HIGH CALIBER, PLEASE ADDRESS INQUIRIES TO VICE PRESIDENT, INDUSTRIAL RELATIONS

Aerojet Proposes Segmented Boosters

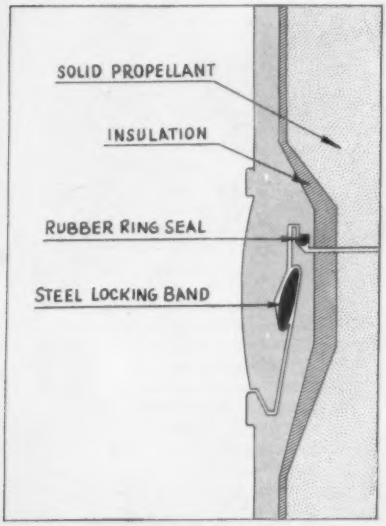
By George Alexander

Washington – Multi-million pound thrust, solid propellant segmented space boosters could be built and could launch payloads within 18 to 24 months and compare favorably with Saturn-type vehicles in cost and performance, Aerojet-General has told Defense Department, Air Force and National Aeronautics and Space Administration.

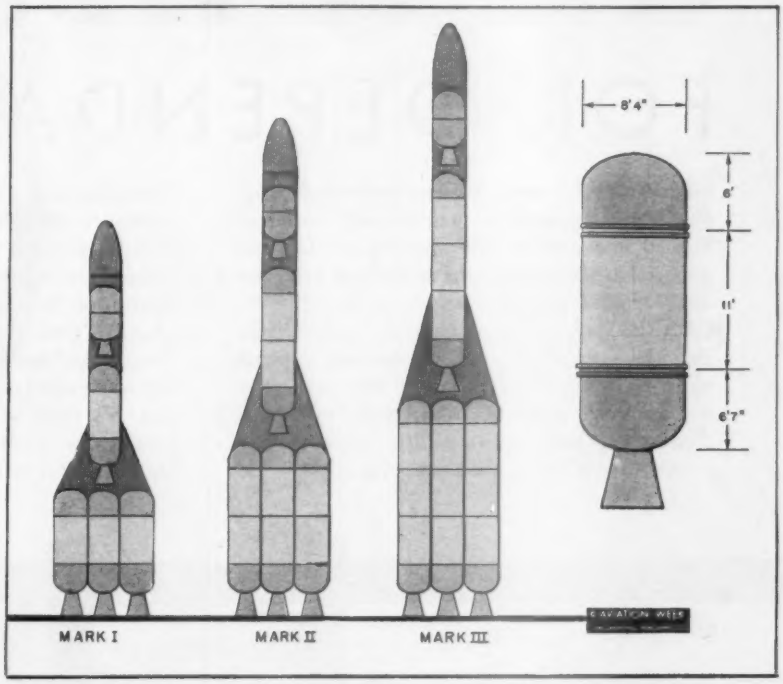
Segments, which can be stacked or clustered in varying lengths and configurations to produce any desired thrust level, consist of:

- **Forward head,** 72 in. long, 100 in. in diameter and filled with 37,000 lb. of propellant.
- **Center section** 132 in. long, 100 in. in diameter and filled with 53,000 lb. of propellant.
- **Aft closure,** 79 in. long, 100 in. in diameter and filled with 37,000 lb. of propellant.

Segments are jointed and sealed by a lock-strip joint (see sketch) and secured by three flexible steel rods inserted at three apertures in the circumference of the joint. Assembly of two units, using an air hammer, takes less than two minutes, Aerojet said.



LOCK-STRIP joint and seal developed by Aerojet-General for its segmented motor program allows assembly of two units in two minutes. Units are joined and then steel rods are air-hammered into the circumferential groove to lock the motors. Rubber O-ring gasket fits the base of each motor and, under pressure of the lock, precludes gas leakage.



SEGMENTED MOTOR (right) proposed by Aerojet to Defense Department, USAF and NASA consists of three standardized building blocks (head, center and aft closure) and can be assembled in varying lengths and configurations to provide any desired thrust. Mark I vehicle would stand 85 ft. tall, weigh 698,600 lb. at launch and could lift 13,000 lb. payload. Mark II would be 109 ft. high, weigh 952,000 lb. at lift-off and put a 19,600 lb. payload in low earth orbit. Mark III would stand 133 ft. tall, weigh 1,188,300 lb. at launch and could place 25,700 lb. into earth orbit.

Propellant would be presently-available polyurethane, aluminum and ammonium perchlorate fuel, with a specific impulse of 245 sec. Aerojet said that the decision to use this particular propellant energy level represents the optimum trade-off between performance and cost. It would run about $1 per processed lb.

Total Impulse

Total impulse of a three-segment motor, 80% volumetrically loaded and with a mass fraction of 90%, would be 20 million lb-sec. Thrust would vary with burning time: 1 million lb. at 20 sec.; 500,000 lb. at 40 sec. and 333,000 lb. at 60 sec.

Aerojet described three all-solid space boosters to the military and civilian agencies: Mark I, II and III. The Mark I, consisting of three complete (head, center and aft section) motors in a cluster as the booster, one complete motor as the second stage and a head and closure assembled to form the third stage, could put 13,000 lb. in a 300-naut.-mi. orbit. The Mark II could put 19,600 lb. in identical orbit, using six center sections in the booster (a cluster of three stacks, two units to a stack, plus heads and closures), two center sections, plus head and closure, in the second stage and a third stage similar to that on the Mark I.

The Mark III could lift 25,700 lb. into that same orbit using nine center sections (a cluster of three stacks, three units to a stack, plus heads and closures) in the first stage, three center units, plus head and closure, in the second stage and in the third stage of Mark I and II.

Of the various types of thrust vector control systems studied, Aerojet reported that the most promising approach appeared to be liquid injection (AW Mar. 20, p. 55), where a fluid is introduced in the gas stream along one side of the nozzle wall to produce an oblique shock wave.

If 30 to 40 vehicles are ordered, Aero-

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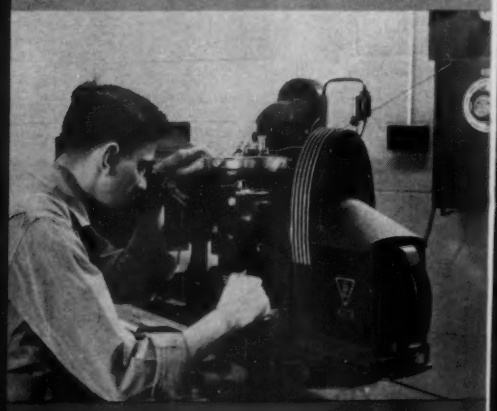
GRAPHITAR'S own character makes it dependable. A non-metallic engineering material, formed from carbon and graphite powders and a special binder, compacted under high pressures and furnaced at temperatures up to 4,500°F., GRAPHITAR possesses inherent characteristics that give finished parts exceptional dependability. GRAPHITAR'S natural heat resistance, for example, gives bearings, seals, vanes and rings exceptional dependability whenever dependability is one of the prime requisites.

There are other characteristics every bit as important to GRAPHITAR'S dependability. They include chemical and magnetic inertness, mechanical strength and adaptability to self-lubrication. Besides these natural characteristics, GRAPHITAR engineers can control porosity, strength and hardness to match GRAPHITAR'S physical properties to each individual application. It's little wonder that GRAPHITAR has become one of the design engineer's most versatile and useful materials.

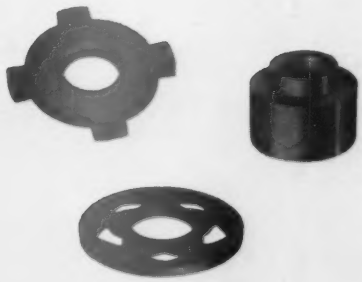
In this laboratory test stand, oxidation-resistant GRAPHITAR parts are being checked under simulated operating conditions. Similar tests have proven that, when GRAPHITAR parts are exposed in oxidizing atmospheres at 1,200°F., they show only a weight loss of less than six percent after 200 hours.



In the Engineering Department of The United States Graphite Company, micro-photo studies are indispensable in the study of internal part structure. The Metallograph is just one of dozens of modern technological aids employed in both the quality control of production GRAPHITAR parts and in the research and development of new products. GRAPHITAR parts are engineered for dependability.

GRAPHITAR air/oil seals employed in today's high-speed turbojet engines have established an enviable record for operating dependability. Installed on the main shaft of the turbine, GRAPHITAR seals successfully withstand tremendous shaft speeds and generated heat.

GRAPHITAR bearings in the power reactor pumps of American nuclear submarines have compiled an outstanding record for dependability.



Unusually shaped parts of GRAPHITAR can be molded easily with today's modern techniques. Ears, face slots and outside diameter notches of friction disc above, left, were molded in one operation without need for secondary machining and finishing.

Do you have an application in which GRAPHITAR'S dependability can help solve a tough problem, reduce your costs and improve the operational life of your products? Our engineering staff can help you find out. Our field men can also give specialized, on-the-job consultation. Send for your free copy of Engineering Bulletin #20. Included is helpful information about the properties, characteristics and applications of GRAPHITAR.

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DIVISION OF THE WICKES CORPORATION, SAGINAW 5, MICHIGAN

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R-294-3

jet estimated that the cost would run about $2 per lb. of rocket. The larger the size of the rocket, the more economical its price—a 1.5 million lb. thrust booster could be had for about $1 million.

Going to larger, 140-in. diameter motors, Aerojet stated, would result in much greater performance yields for only modest cost increases. A booster consisting of 140-in. diameter units could place payloads in orbit for about $350 per lb. of payload, compared with the $500-$700 per payload lb. now estimated for Saturn.

Although Aerojet proposed 100-in. diameter motors as more readily available, they said that 140-in. units could be turned out within 30 months. A cluster of 14 such motors, in seven stacks of two each, would deliver about 14 million lb. thrust in 70 sec. burning time.

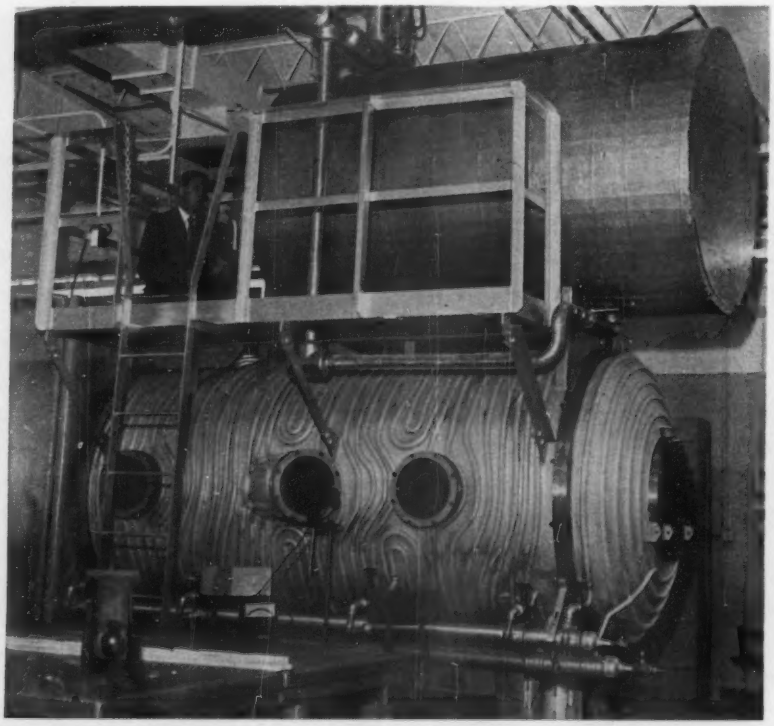
Aerojet, along with Thiokol and Grand Central Rocket Co., recently completed a six-month study for NASA (AW Sept. 19, p. 28) on the feasibility and economics of using large solid boosters, with liquid oxygen-liquid hydrogen upper stages, in vehicles weighing 1 million and 7 million lb.

Payloads would be placed on both orbit and escape missions.

Thiokol recommended large, unsegmented motors (AW Jan. 16, p. 34); Aerojet adopted the segmented approach.

The company suggested that the 7-million-lb. vehicle could be powered by a cluster of seven 140-in. diameter motors and that such a vehicle could place 350,000 lb. in earth orbit or 170,000 lb. in a deep space probe. The 1-million-lb. rocket could be lifted by either a cluster of four 100-in. diameter motors, or a single 140-in. diameter unit.

This system could lift 45,000 lb. into earth orbit or 16,700 lb. into far space.



ION ENGINES designed and produced by Rocketdyne will be tested in this vacuum tank in company's new Electrical Propulsion Laboratory. Tank, five feet in diameter and 12-ft. long, is largest of six in laboratory. It can be used to test ion engines up to $\frac{1}{10}$-lb. thrust.

Ion Engine Laboratory Completed

Laboratory for development and testing of electrical propulsion systems has been completed at Rocketdyne Division of North American Aviation, Inc., Canoga Park, Calif.

The Electrical Propulsion Laboratory includes six space simulating vacuum tanks and will provide complete research and development for ion, arc jet and colloid thrust devices and propellant feed systems, controls and instrumentation.

Also integrated into the laboratory are eight large power units which provide a direct current power output totaling 800 kw. and an electrolytic tank simulator.

Soviets Describe Tests Given to Space Dogs

Moscow—Russian canine cosmonauts are mongrels which undergo about one year of testing and conditioning before being fired into space, the Soviet press reports.

A Tass writer who visited the scientific laboratory where the animals are trained and cared for reported these findings:

- **All four dogs recovered** from space thus far—Belka, Strelka, Chernushka and Zvyozdochka—were mongrels with vague Spitz heritage. Although they would not rate well in a dog show, "the dogs' rough upbringing in the street has made them hardy and resistant to any vicissitudes of life," and thereby suited for cosmic research.
- **In order to teach** the space-dog candidates to live in a restricted space, they are first put in a small yard, then placed for longer and longer periods into increasingly smaller cages. The last of the cages is the same size as a rocket cabin.
- **Dogs must become accustomed** to wearing space garments—those which resist them are disqualified. The Soviets say they have noticed the task is easier if the garments are fitted closely.
- **Space-dog candidates** at first receive such standard food as porridge, meat and bones but "shortly before flight the dogs are put on a special ration which is issued by an automatic device. At first the automatic feeder puzzles and even frightens some dogs. Jellies offered to the dog contain all necessary nutritive substances and water is given in amounts that satisfy daily requirements."
- **To test and condition the animals** to space-flight conditions, they are placed in thermal chambers to determine their resistance to high temperatures. "At first the dog remains calm, then as the temperature rises it begins to breathe more frequently and to open its mouth . . . breathing becomes very fast. Gradually the temperature is lowered and the test brought to an end." The animal is then released and offered food and water.

"The dogs become accustomed to extra gravity loads in a centrifuge. Special tests are made to determine their resistance to rarified atmosphere, oxygen shortage, vibrations, rocket engine noise and other unusual conditions.

"Sometimes tolerance of a dog's organism to this or that influence proves different from that of man. But scientists know how to make allowances for peculiarities of the human organism. Thus experiments with animals provide scientists with information which serves as a point of departure in working out measures to ensure the safety of manned flight into space."

Space Vehicle Log

(As of April 1, 1961)

Satellites in Orbit	Name	Source	Launch	Period Min.	Apogee Stat. Mi.	Perigee Mi.	Transmission[1] Freq. (mc.)	Estimated Lifetime
1958 Alpha	Explorer I	US	1 Feb. 58	106.8	1130	220	108-108.03	7-10 yr.
1958 Beta 1	Rocket Body	US	17 Mar 58	138.4	2689	406		200-1,000 yr.
1958 Beta 2	Vanguard I	US	17 Mar 58	133.7	2438	407	108.022[2]	200-1,000 yr.
1959 Alpha 1	Vanguard II	US	17 Feb 59	125.3	2046	343	108-108.03	100-250 yr.
1959 Alpha 2	Rocket Body	US	17 Feb 59	129.5	2272	348		100-250 yr.
1959 Delta	Explorer VI	US	7 Aug. 59	Position Uncertain			108.06-108.09	Uncertain
1959 Eta	Vanguard III	US	18 Sept. 59	129.8	2318	316	108-108.03	50-150 yr.
1959 Iota 1	Explorer VII	US	13 Oct. 59	101.1	670	344	19.9904[2]	30-40 yr.
1959 Iota 2	Rocket Body	US	13 Oct. 59	101.0	663	342		30-40 yr.
1960 Beta 1	Rocket Body	US	1 Apr. 60	99.1	464	429		50-100 yr.
1960 Beta 2	Tiros I	US	1 Apr. 60	99.1	467	429	107.997[2]	50-100 yr.
1960 Gamma 1	Rocket Body	US	13 Apr. 60	92.4	310	179		2 yr.
1960 Gamma 2	Transit 1B	US	13 Apr. 60	95.1	425	229	54-162-216	6 yr.
1960 Epsilon 1	Sputnik IV	USSR	15 May 60	92.9	343	175	19.995	2-3 yr.
1960 Epsilon 3	None	USSR	15 May 60	93.5	383	172		3-4 yr.
1960 Epsilon 4	None	USSR	15 May 60	92.9	343	176		Uncertain
1960 Zeta 1	Midas II	US	24 May 60	94.3	316	297		8-15 yr.
1960 Eta 1	Transit 2A	US	22 June 60	101.6	650	389	54; 162; 216; 324[2]	50-200 yr.
1960 Eta 2	Greb	US	22 June 60	101.6	656	381	108.0[3]	50-200 yr.
1960 Eta 3	Rocket Body	US	22 June 60	101.4	643	383		50-200 yr.
1960 Iota 1	Echo I	US	12 Aug. 60	117.1	1280	651	108.06-107.93	2-10 yr.
1960 Iota 2	Rocket Body	US	12 Aug. 60	118.0	1049	932		4,000 yr.
1960 Iota 3	Metal Object	US	12 Aug. 60	118.2	1050	941		2,500 yr.
1960 Iota 4	Metal Object	US	12 Aug. 60	118.2	1044	950		400 yr.
1960 Iota 5	Metal Object	US	12 Aug. 60	118.4	1064	940		2,500 yr.
1960 Nu 1	Courier 1B	US	4 Oct. 60	106.8	749	604	107.97[2]	200-500 yr.
1960 Nu 2	Rocket Body	US	4 Oct. 60	106.4	748	578		200-500 yr.
1960 Xi 1	Explorer VIII	US	3 Nov. 60	112.6	1414	262	108	20-50 yr.
1960 Xi 2	Rocket Body	US	3 Nov. 60	112.5	1413	259		20-50 yr.
1960 Pi 1	Tiros II	US	23 Nov. 60	98.2	463	378	108.0; 108; 03[3]	200-500 yr.
1960 Pi 2	Rocket Body	US	23 Nov. 60	98.1	458	378		200-500 yr.
1960 Sigma	Discoverer XVIII	US	7 Dec. 60	90.8	244	143		Uncertain (capsule recovered)
1961 Alpha I	Samos II	US	31 Jan. 61	95.0	344	295		
1961 Alpha II	Metal Object	US	31 Jan. 61	95.0	343	295		
1961 Beta 3	None	USSR	4 Feb. 61	88.7	130	130		
1961 Delta 1	Explorer IX	US	16 Feb. 61	118.3	1605	395	136	1 yr.
1961 Delta 2	Rocket Body	US	16 Feb. 61	118.4	1612	395		
1961 Epsilon I	Discoverer XX	US	17 Feb. 61	95.3	480	177		
1961 Zeta	Discoverer XXI	US	18 Feb. 61	97.5	640	151		
1961 Eta 1	Transit 3B & Lofti	US	22 Feb. 61	93.2	429	117	54; 162; 216;[2] 324; 136.2; 136.8	

Lunar and Space Probes		Source	Launch	Status	Transmission
Pioneer IV		US	3 Mar. 59	Orbiting Sun	960.05
Lunik I	(Mechta)	USSR	2 Jan. 59	Orbiting Sun	19.997-19.995-19,993-183.6
Lunik II		USSR	12 Sept. 59	Hit Moon—13 Sept. 59	183.6-39.986-19.993-20.003
Pioneer V	(60 Alpha)	US	11 Mar. 60	Orbiting Sun	378 (and 150 watts)
Venus Probe	(61 Gamma I)	USSR	12 Feb. 61	Expected to pass Venus 20 April 61, Orbiting Sun	922.8

Decayed Objects

Object	Code Name	Source	Launch	Decay	Transmission Freq. (mc.)
1957 Alpha 2	Sputnik I	USSR	4 Oct. 57	Early Jan. 58	20.005-40.002
1957 Beta	Sputnik II	USSR	3 Nov. 57	14 Apr. 58	20.005-40.002
1958 Gamma	Explorer III	US	26 Mar. 58	28 June 58	108-108.03
1958 Delta 2	Sputnik III	USSR	15 May 58	6 Apr. 60	20.005-40.01
1958 Epsilon	Explorer IV	US	26 July 58	23 Oct. 59	108-108.03
1958 Zeta	Atlas	US	18 Dec. 58	21 Jan. 59	132.435-132.905-107.97-107.94
1959 Beta	Discoverer I	US	28 Feb. 59	5 Mar. 59	
1959 Gamma	Discoverer II	US	13 April 59	26 April 59	
1959 Epsilon 1	Discoverer V	US	13 Aug. 59	28 Sept. 59	
1959 Zeta	Discoverer VI	US	19 Aug. 59	20 Oct. 59	
1959 Theta	Lunik III	USSR	4 Oct. 59	20 April 60	103.6-39.986
1959 Kappa	Discoverer VII	US	7 Nov. 59	26 Nov. 59	
1959 Lambda	Discoverer VIII	US	20 Nov. 59	8 Mar. 60	
1960 Delta	Discoverer XI	US	15 Apr. 60	26 Apr. 60	
1960 Theta	Discoverer XIII	US	10 Aug. 60	14 Nov. 60	
1960 Kappa	Discoverer XIV	US	18 Aug. 60	16 Sept. 60	
1960 Lambda 1	Sputnik V	USSR	19 Aug. 60	20 Aug. 60[3]	19.995
1960 Mu	Discoverer XV	US	13 Sept. 60	18 Oct. 60	
1960 Omicron	Discoverer XVII	US	12 Nov. 60	29 Dec. 60	
1960 Rho 1	Sputnik VI	USSR	1 Dec. 60	2 Dec. 60	19.995
1960 Tau	Discoverer XIX	US	20 Dec. 60	23 Jan. 61	
1961 Beta 1	Sputnik VII	USSR	4 Feb. 61	26 Feb. 61	19.995
1961 Gamma 3	Sputnik VIII	USSR	12 Feb. 61	25 Feb. 61	19.995
1961 Theta I	Sputnik IX	USSR	9 Mar. 61	9 Mar. 61[4]	19.995
1961 Iota	Sputnik X	USSR	25 Mar. 61	25 Mar. 61[3]	19.995
1961 Kappa	Explorer X	US	25 Mar. 61	[4]	108

Notes: 1) Where transmission frequencies and lifetime estimates are not given, they are not available; 2) Still transmitting, no video from Tiros I; 3) USSR announced successful re-entry and recovery; 4) Contact lost after 60 hr., expected to make no more than two earth orbits with initial elements of 112,500-110 mi. Also in orbit are pieces of rocket bodies or payloads from Explorer VIII (1960 Xi 3); Tiros II (1960 Pi 4); Explorer IX (1961 Delta 3 and 4) and Discoverer XX (1961 Epsilon 2, 3 and 4).

Sources: National Aeronautics and Space Administration Space Operations Control Center, North American Air Defense Command (Norad), and Smithsonian Astrophysical Observatory.

NEW DEPARTURES IN MINIATURE

A SIGNIFICANT "BEARING" ON TERRIER GUIDANCE

N/D MINIATURE AND INSTRUMENT BALL BEARINGS HELP SOLVE COST PROBLEM IN SUPERSONIC MISSILE

PROBLEM: Guidance system in Terrier missile required miniature and instrument ball bearings that help reduce high cost of assembly and meet rigid reliability standards.

SOLUTION: N/D Sales Engineer, cooperating with the Iron Fireman Manufacturing Company, recommended the use of flanged instrument bearings in the gyro rotor and the outer gimbal positions. Result: Flanged bearings simplified both mountings and resulted in substantial assembly cost savings. Moreover, a N/D miniature ball bearing . . . similar to the bearing pictured between tweezer nibs . . . is used in the gyro caging cam. It also has a vital "bearing" on the Terrier's reliability and performance.

Furthermore, numerous tests in New Departure's R & D facilities proved the bearings to be capable of meeting all environmental demands before gyro production changes were made.

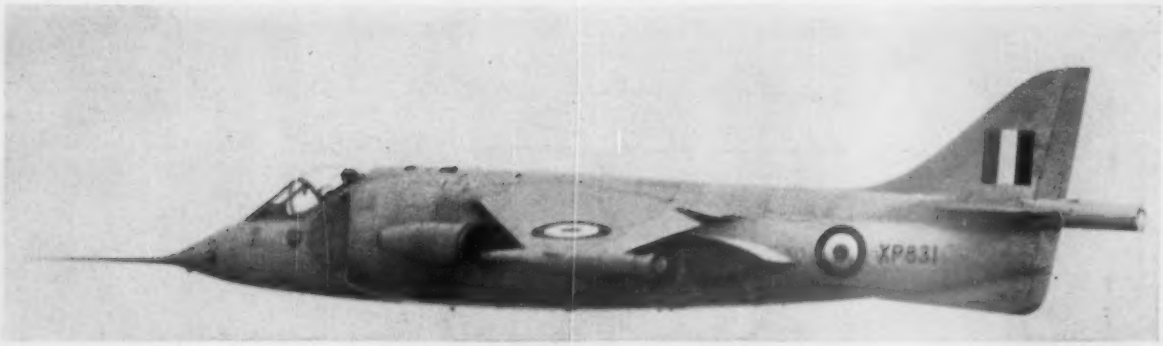
If you would like Miniature/Instrument ball bearing application assistance, please invite the N/D Sales Engineer in your area to participate in your early design discussions. He may point the way to assembly cost savings. Or, call or write New Departure, Division of General Motors Corporation, Bristol, Connecticut.

Visit our Exhibit—Booth No. 118-120, Design Engineering Show, May 22-25, Cobo Hall, Detroit, Mich.

Send for the New Departure Miniature and Instrument Ball Bearing Catalog and White Room Brochure today. Write to Department L. S.

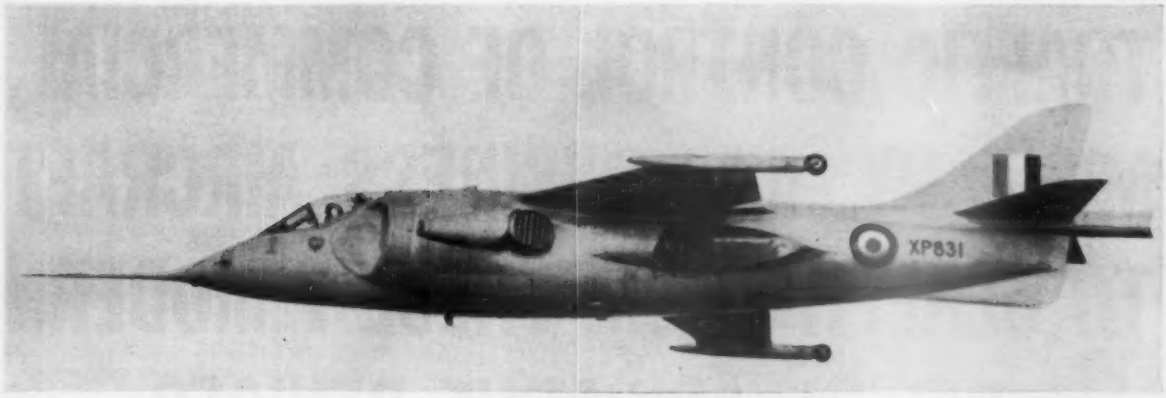
NEW DEPARTURE

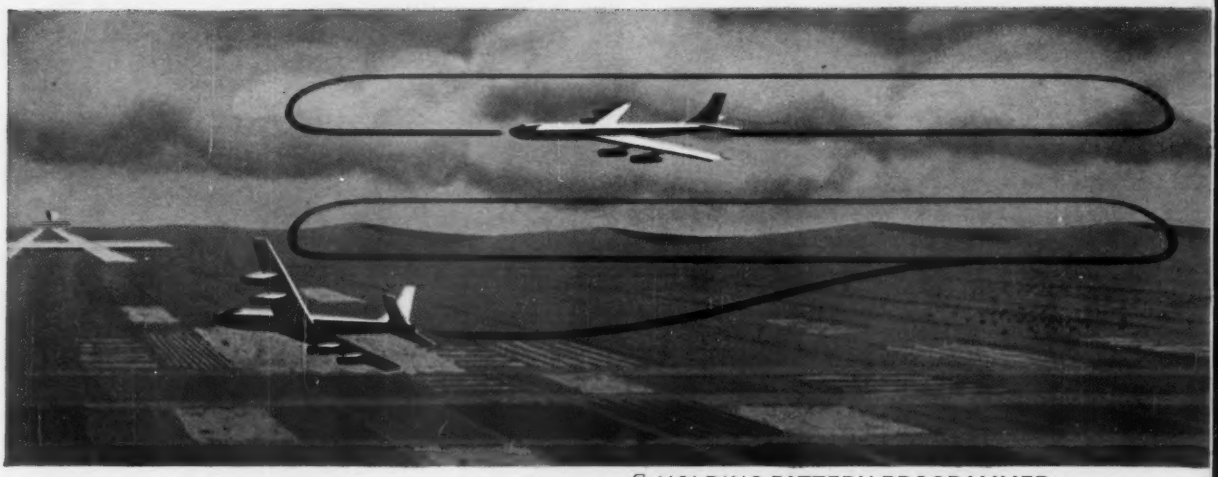
MINIATURE AND INSTRUMENT BALL BEARINGS



Hawker P.1127 NATO Entry Conventionally Flown

Hawker P.1127 VTOL fighter, powered by a Bristol Siddeley BS.53 forward fan turbojet with a design thrust rating approximating 15,000 lb., is shown in free flight in which special bell mouth lips for the engine air intakes appear to be removed. Earlier the British NATO entry completed hovering tests (AW Dec. 5, p. 33). Wingspan is 24 ft. 4 in. Conventional ailerons are fitted for lateral control during non-hovering flight. Landing gear is twin tandem installation, with twin main wheels aft of center of gravity and single nosewheel forward.



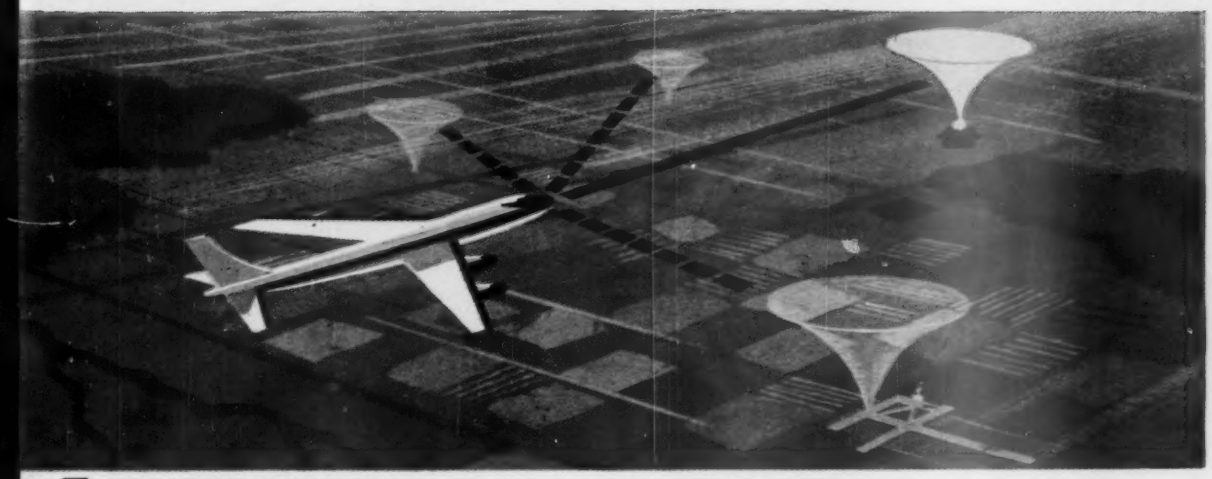


1 HOLDING PATTERN PROGRAMMER: Programs Automatic Flight Control System to fly prescribed holding patterns, automatically correcting for wind.

TRAFFIC CONTROL OF COMMERCIAL, MILITARY, AND BUSINESS AIRCRAFT TO BENEFIT FROM THESE 7 MODERN BENDIX AIRBORNE DEVICES

4 TO-FROM BEEPER: Gives audible signal during VOR station crossing, or at beam intersection, relieving pilot of tiring instrument concentration.

5 AUDIO CO-PILOT: An experiment in converting instrument flag warnings and selected flight data to audible signals (e.g.: calling out approach and take-off airspeeds).



2 **VORTAC COMPUTER:** Through airborne computation, creates phantom Vortac station where needed for parallel routing through congested areas and for direct flight navigation to destinations with limited navigation facilities. Provides constant readout of bearing and distance information.

Knowmanship in Action

Since introducing the "earth inductor" compass in aviation's early days, Eclipse-Pioneer has been responsible for a wide array of control and navigation equipment that has anticipated aviation's ever-growing, ever-changing needs. All seven devices shown on these pages are important new advances keyed to jet-age problems and ready to aid in relieving the cockpit pressures of navigation and traffic control.

TECHNICAL KNOWLEDGE + EXPERIENCED MANAGEMENT + SPECIALIZED CRAFTSMANSHIP = **KNOWMANSHIP**

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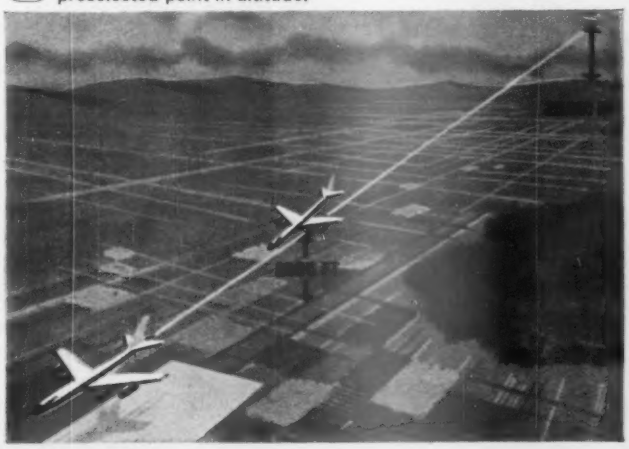
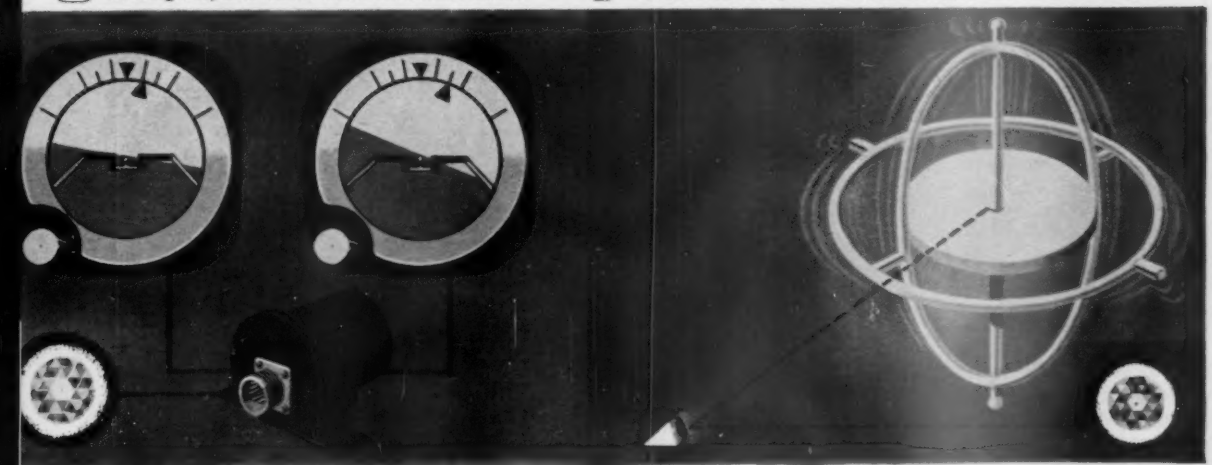
THE Bendix CORPORATION

3 **VERNAV (Vertical Navigator):** Automatically computes and flies optimum climb or descent path to any preselected point in altitude.



6 **SIGNAL COMPARATOR:** Compares signals from two like systems (i.e.: horizons, compasses, any synchro signals) and warns when difference exists.

7 **TWO-AXIS GYRO MONITOR:** Warns when gyro is not erected to vertical. When used with a Signal Comparator in a dual system, tells which gyro is malfunctioning.



Shipments of Civilian Aircraft and Engines

Item		February 1961	January 1961*
Complete aircraft, number[1]		587	692
Fixed-wing		572	680
Multi-engine		115	110
30 place and under		98	91
31 place and over		17	19
Single engine		457	570
3 place and under		162	155
4 place and over		295	415
Rotorcraft		15	12
Value of shipments of complete aircraft and aircraft parts	$1,000	91,904	94,579
Aircraft		81,799	82,096
Aircraft parts		10,105	12,483
Complete aircraft, total airframe weight	1,000 lb.	1,914.9	1,995.5
Fixed-wing		1,901.7	1,979.0
30 place and under		642.5	722.2
31 place and over		1,259.2	1,256.8
Rotorcraft		13.2	16.5
Value of shipments of aircraft engines and engine parts	$1,000	24,033	22,679
Aircraft engines (including reciprocating, gas-turbine, and turboprop		12,647	13,263
Aircraft engine parts		11,386	9,416

*Revised.
[1]Unfilled orders of aircraft 3,000 lb. airframe weight and over amounted to 555 at the end of February, 1961, and 553 at the end of January, 1961.

PRODUCTION BRIEFING

Minneapolis-Honeywell Regulator Co. will develop the secondary attitude reference subsystem for the Dyna-Soar space glider under a multi-million dollar Air Force contract. The subsystem will serve as a backup and monitor for the primary guidance subsystem.

Aerojet-General Corp. has received a $500,000 nuclear engine research contract from the Air Force. Aerojet is preparing preliminary design criteria for nuclear propulsion systems ranging from the upper stage thrust levels to multi-million pound thrust boosters. The study also will provide development requirements, facilities, scheduling and costs associated with the various designs.

AiResearch Division of the Garrett Corp. will design and manufacture the air conditioning system for the 727 jet under a multi-million dollar contract from Boeing Airplane Co.

Five major companies have formed a Missile Facilities Activation and Maintenance (MFAM) task group to provide management and technical support for the activation and maintenance of missile bases and launching facilities for operational Atlas, Titan and Minuteman intercontinental ballistic missiles. The companies are: Borg-Warner Corp., Del E. Webb Corp., Hallicrafters Co., Newberry Electric Corp. and Scott Co.

National Research Corp., Cambridge Mass., has received a $49,520 contract from the USAF Office of Scientific Research for a study on effects of a high altitude, near-vacuum environment on the mechanical properties of structural materials.

Collins Radio Co., Cedar Rapids, Iowa, will manufacture horizontal situation indicator instruments for use on Air Force twin-jet training planes under a $1,307,919 contract. Designated the AQU-2/A, the indicator is a panel-mounted instrument giving a complete map-view of the navigation situation by providing a combination of course, approach distance, bearing and drift angle information.

Food Machinery and Chemical Corp., will build an additional pilot model of a vehicle for carrying Mauler missiles under a $130,610 Army contract.

Permanent Filter Corp., Los Angeles, is building a new manufacturing facility at North Long Beach, Calif., which will encompass 50,000 sq. ft, including 38,000 sq. ft. for factory working area.

Ryan Aeronautical Co. will manufacture aluminum mirrors, 78 in. in diameter and 22 in. deep, for Sylvania Electric Products, Inc., for use in an improved type of military radar installation. Ryan will use a 35-ton ductile iron die to maintain contour and dimensions in the mirror's parabolic shape within tolerances of one or two thousandths of an inch.

B. F. Goodrich Aviation Products, Akron, Ohio, will install its liquid-cooled brake system on United Air Lines Boeing 720 jet transport. The brakes incorporate a liquid-to-liquid heat exchanger to keep temperatures below 500F.

Link Division of General Precision, Inc., has been awarded two Air Force contracts totaling more than $6 million for delivery of C-130 flight simulators and development and manufacture of visual simulator trainer attachments.

Bendix Corp. has been awarded two contracts totaling $27.3 million by Convair Division of General Dynamics Corp., prime contractor for the B-58. First contract, for $23 million, is to build control systems for an additional 50 aircraft; remaining $4.3 million is for production conversions of previously built B-58s to present tactical configuration and modification of four of the aircraft to trainers.

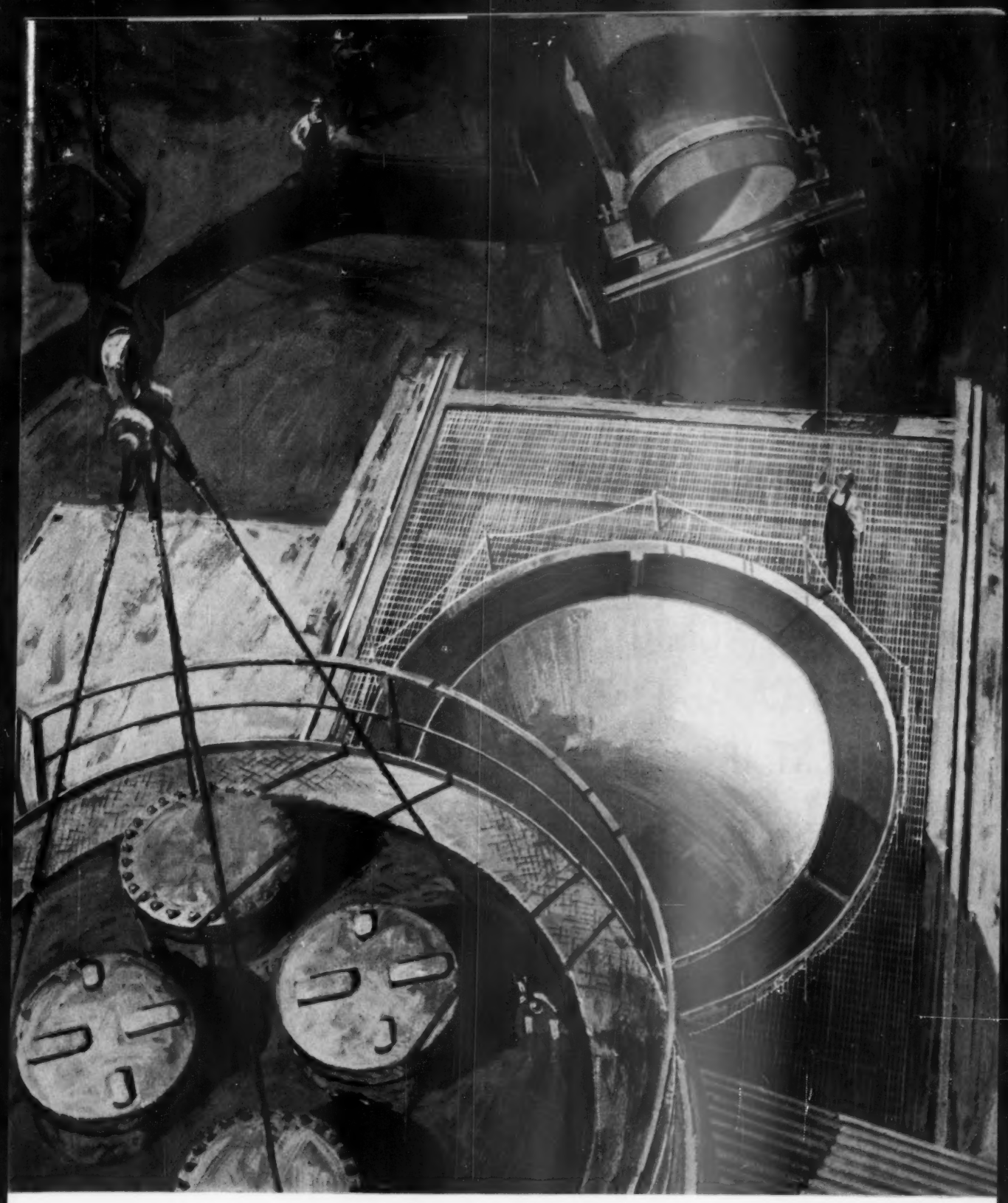
Electro-Optical Systems, Inc., has received two NASA contracts for analysis of tests evaluating performance of electrostatic propulsion systems in space ($119,160) and for ionizer development and surface physics studies ($74,941), including experimental research and development of porous tungsten ion emitters.

Thiokol Chemical Corp.'s Longhorn Division has received a $4,936,812 continuation contract from the Army for final assembly and loading of various missile motors. Changes also are being made at the Longhorn plant to permit production of the Pershing propulsion system.

Bendix Corp. will make five additional emplacement systems for lowering Minuteman missiles into underground launch tubes. Boeing Airplane Co. awarded the contract worth nearly $1 million.

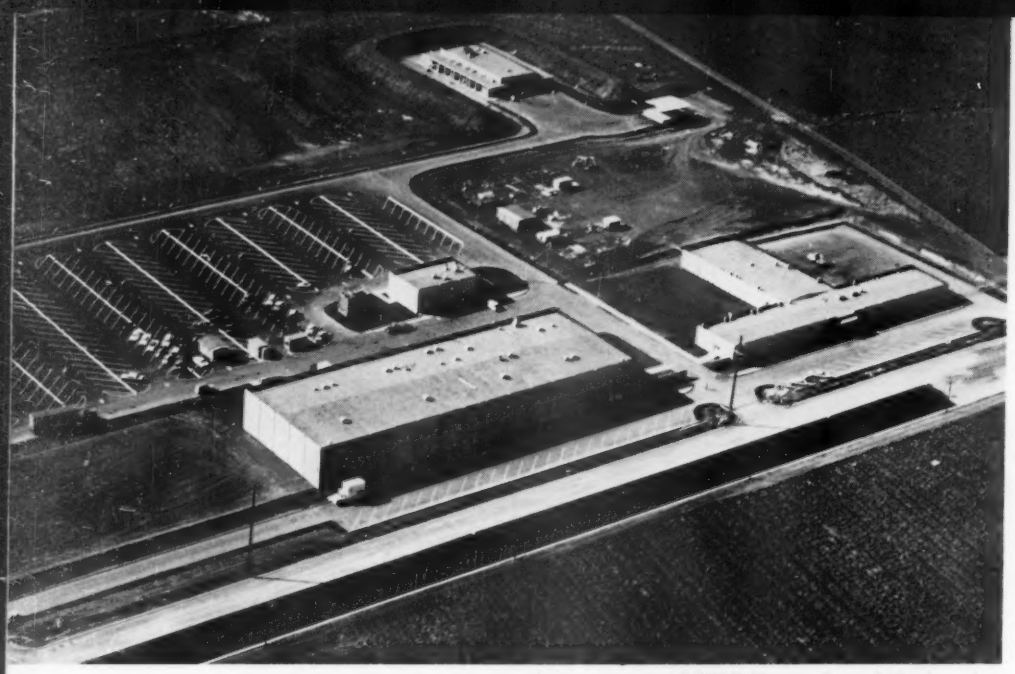
Raytheon Co. has received contracts totaling $56,894,827 from the Boston Ordnance District for continued production, engineering and field service work on the Hawk missile system.

GE's Light Military Electronics Dept. has received a $195,000 contract for design and development of an electrostatic gyroscope for use in spacecraft. California Institute of Technology's Jet Propulsion Laboratory, a NASA research facility, awarded the contract.



UNITED TECHNOLOGY CORPORATION DEDICATES NEW ROCKET PROPULSION COMPLEX NEAR SAN FRANCISCO

HUGE LID is lifted from an in-ground curing oven for solid propellant rockets at UTC Development Center. This particular oven is the largest in the free world.



AERIAL VIEW of UTC Research and Engineering Center in Sunnyvale, California, shows Administration and Engineering Buildings and Research and Testing Laboratories.

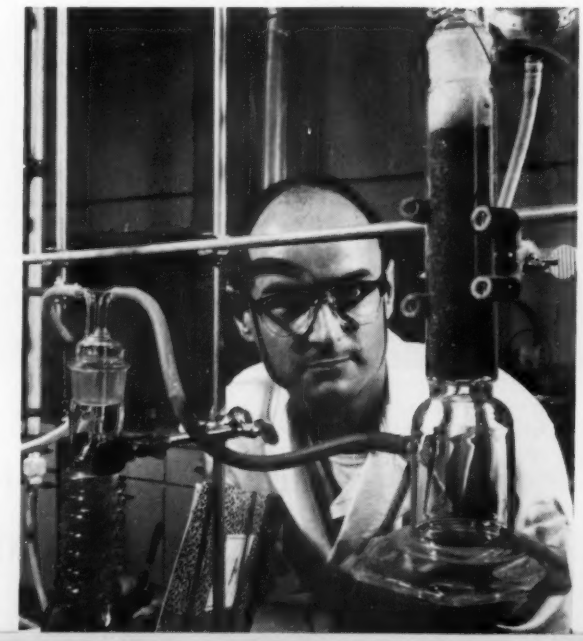
UNITED TECHNOLOGY CORPORATION FACILITY PROVIDES CAPACITY FOR DEVELOPMENT AND TEST OF BIGGEST U.S. SOLID PROPELLANT ROCKETS

Dedication of privately-financed installation is significant milestone in 41-year history of pioneer propulsion organization

With work well underway on a broad range of propulsion research and development activities, United Technology Corporation has officially dedicated its new facility in the San Francisco Bay Area.

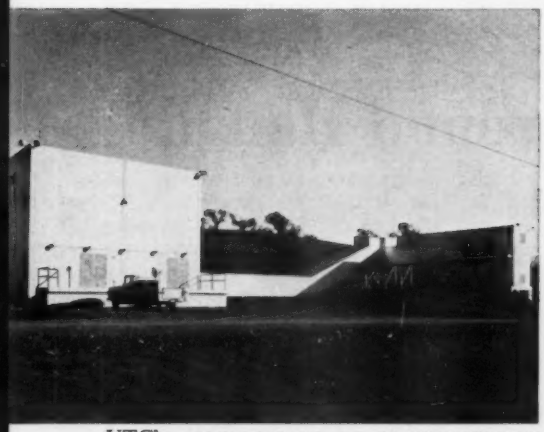
Here all the necessary equipment and facilities for basic research, prototype evaluation, final development, and processing of solid and liquid rockets have been integrated into a modern, functional complex.

The photos here give some indications of the capacity of these facilities.



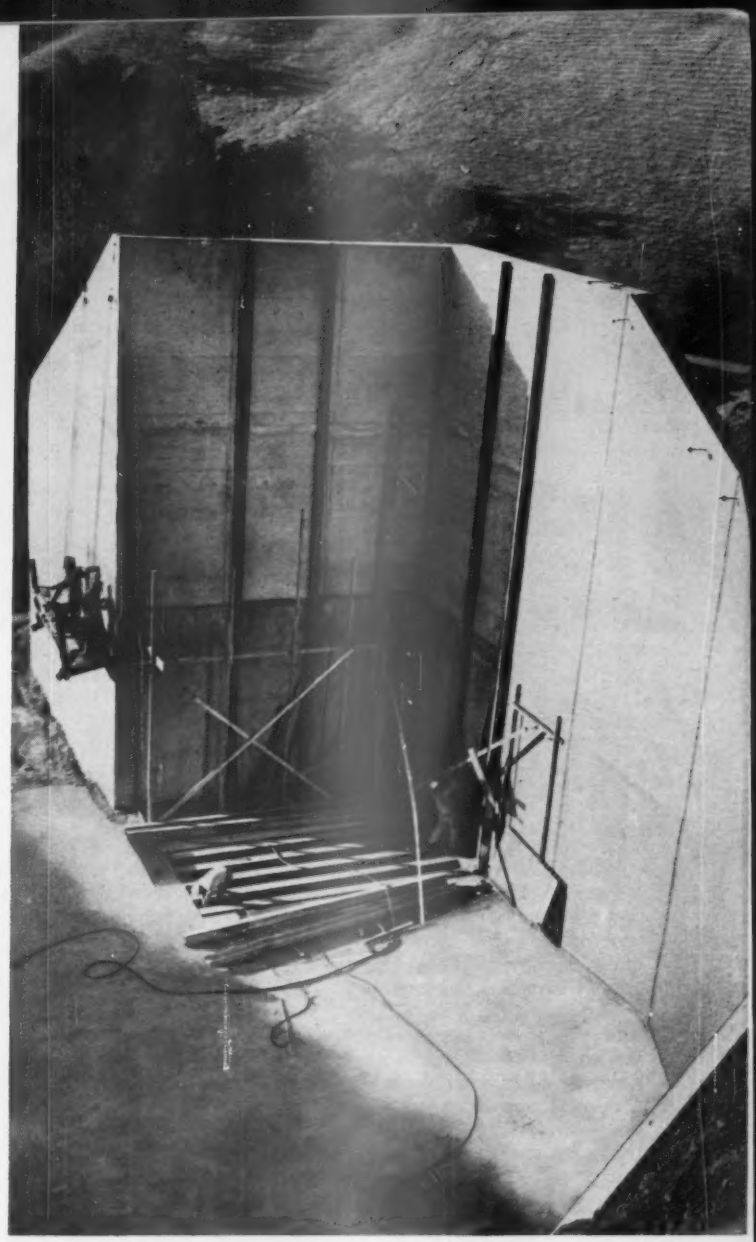
HIGHLY SKILLED and experienced scientists and engineers are conducting a full range of propulsion research and development activities at UTC's new installation.

VIEW OF ENTRANCE to the 3200 acre Development Center, located in foothills a short distance from Sunnyvale, which includes the world's most modern propellant processing plant and test facilities for both solid and liquid rockets.



UTC's SOLID-PROPELLANT MANUFACTURING PLANT has capacity to produce in excess of a million pounds of propellant per month.

HUGE PROPELLANT MIXER is one of four included in UTC processing line.



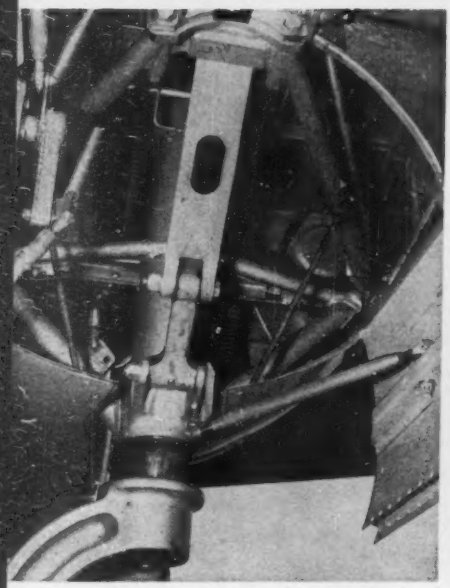
TOWERING TEST STAND at the Development Center will accommodate very large solid rockets. In addition, four medium sized solid rocket test cells and two liquid propellant test stands are available for developmental work. Each is connected to a remote control center which houses equipment for test control and data acquisition.

Capability backed by four decades of propulsion experience

UTC UNITED TECHNOLOGY CORPORATION

A subsidiary of United Aircraft Corporation

P. O. Box 358, Sunnyvale, California



VIEW into main landing gear wheel well shows part of the bolt-in truss (left). Original main landing gear mount on the main spar is used. First Volpar tri-gear conversion (right) was a standard C-45G before modification with the exception of electrically operated cowl flaps.

Aviation Week Pilot Report:

Tri-Gear Eases Beech Ground Handling

By William S. Reed

Pacoima, Calif.—Recently certificated conversion of a twin Beech from conventional to a new tricycle landing gear offers improvement in the aircraft's ground handling characteristics.

Designated the Volpar Tri-gear Conversion by the designer-builder, the conversion, available in kit form, has a new forward section complete with nose gear, new main gear forks, wheels and brakes and bolt-in main landing gear trusses requiring no major airframe rework.

Ruggedness of design and ease of operation has been proven during Federal Aviation Agency certification trials in which the aircraft was operated in 90-deg. crosswinds of 30 kt. and in one day performed more than 100 landings.

During a recent flight and series of landings in the first Volpar tri-gear conversion, this AVIATION WEEK pilot tried different landing techniques consisting of full and partial flap, fast and slow approaches ending in no-stall and full-stall landings with nearly equal results—acceptable landings in all cases. The Volpar Beech at no time exhibited undesirable ground handling qualities. It appeared virtually impossible to drag the tail even on a full-stall landing.

Taxiing the tri-gear aircraft is accomplished by use of wheel brakes and differential power such as used in aircraft without steerable nose wheels like the B-25 and B-26. Over-the-nose visibility is good and S-turning on the ground is not required. Control at all times is positive.

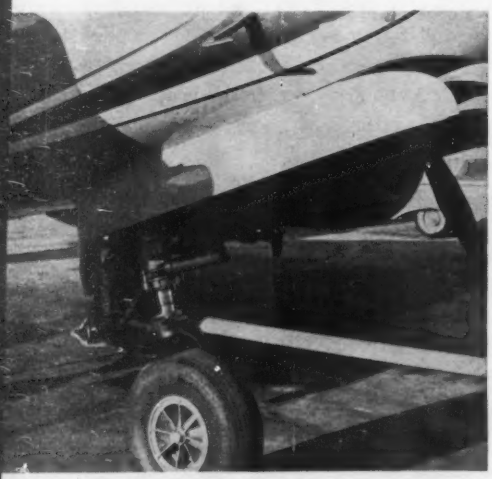
Full-Power Runup

During runup, with owner Dick Hansen in the right seat, it was demonstrated that full power can be applied to either engine independently or to both at once without applying excessive forces to either the main or nose gear. Brakes are adequate to hold the aircraft during a full-power runup of both engines.

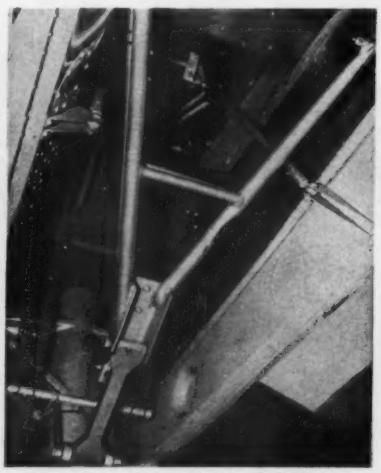
Takeoff is remarkably simple because of the aircraft's inherent tendency to roll straight and because rudder control is available immediately as a result of propeller slipstreams over the tail. Liftoff occurs at 60 to 65 mph. and gear retraction takes 9 sec. Everything about the Volpar prototype, N2802G, is standard C-45G with the exception of the gear and the addition of electrically operated cowl flaps. Main reason, Hansen explains, is so that FAA certifications tests could be run to determine that the conversion had not compromised performance of the original aircraft in any way.

In other words, the FAA, in certificating the aircraft, is satisfied that performance and safety are as good as or better than the original aircraft. Therefore, no other modifications, of which many are on the market, were made to the aircraft.

Cockpit controls are identical to



NOSE SECTION on the Volpar conversion is a completely new, flush-riveted structure from station 46.0 forward.



VIEW up into nosewheel of Volpar conversion shows simplicity of installation.

Soviet Glider Plants

Moscow—Russian designer O. K. Antonov has called on Soviet authorities to stop building gliders in "huge aircraft plants," where the manufacturing cost is "three times as much" as it should be.

Writing in the newspaper Izvestia, Antonov, whose factory builds both four-turboprop transports and gliders, suggested that a specialized glider factory be established, preferably in the Ukraine. He also emphasized his belief that the government was stifling the initiative of Russian glider enthusiasts—and especially amateur designers—by providing too much help and supervision.

"Independent action must be the moving force in gliding," Antonov declared. "Interest and love of the sport cannot be replaced by state personnel and financing."

those in a C-45 and the Volpar Beech uses the standard landing gear position indicator with which the aircraft was originally equipped except that the tail wheel indicator now applies to the nose wheel. Landing gear normal and emergency controls remain the same, permitting transition from one aircraft to the other without noticeable cockpit procedure change.

All landings are typical of tricycle gear aircraft in that the tendency of the machine is to go in the direction of the ground path prior to landing rather than move in the direction headed. A deliberate attempt must be made in order to land the aircraft three points and this can be done without damage to the nose gear. Generally, however, all landings will occur main gear first. Technique has to be quite bad before trouble is encountered on landing.

Taxiing is very smooth in the aircraft because, although the original Beech main gear struts are used, the oleo metering pins have been modified to provide a softer "ride."

Modification was performed by Volitan Aviation, Inc., with the machine work on parts done by Paragon Tool and Die, Inc. Combination of Volitan and Paragon produces Volpar, the name applied to the joint venture by Volitan President Frank Nixon and Paragon President Dick Hansen.

Beech Models C-45G, C-45H and D-18S aircraft can be equipped with the tri-gear by any adequately-equipped aircraft shop. It is unnecessary to remove engines, wings or any significant areas of skin. To prepare the aircraft for conversion it is placed on jacks and leveled. Nose section from station 46.0 forward is removed leaving 3-in.-long stringer stubs. Main landing gear and tail wheel are removed, as are cabin interior side panels and main fuel tanks.

Kit installation consists of bolting the main landing gear trusses to the main center wing spar and bolting in the auxiliary truss between the main landing gear trusses and the fuselage. The latter is to increase the torsion of the main spar, necessary because of the farther aft placement of the struts. Next, the main gear retraction gear boxes are added followed by the main gear and the fairing doors and actuating mechanism. Fuel tanks and cabin interior side panels are replaced followed by the new nose section and gear. Nose gear doors, sealing of the tail wheel well and adding a tail bumper completes the installation.

Installation of a tricycle gear increases the weight of the airframe by 100 lb. and results in moving the center of gravity forward one inch. Adequate room is left in the new, flush-riveted nose for the installation of weather radar antennas, radio gear and some baggage. All material supplied in the kit is either purchased new or manufactured new by Volpar from raw stock. The three wheels are of the same size and are standard Goodyear items to minimize spares stock. Included in the kit are new main gear forks and brakes plus an entirely new nose gear.

Design gross weight of the gear, to which it has been tested and approved, is 10,000 lb., although the aircraft gross is restricted to 9,800 lb. Static tests on the structure and drop tests on the gear have been completed to 150% of design without damage to gear or permanent set in the structure.

Volpar is now tooling for kit production with July 1 as the target date for availability. Eastern distribution of the kits will be handled by Capital Aviation Inc.

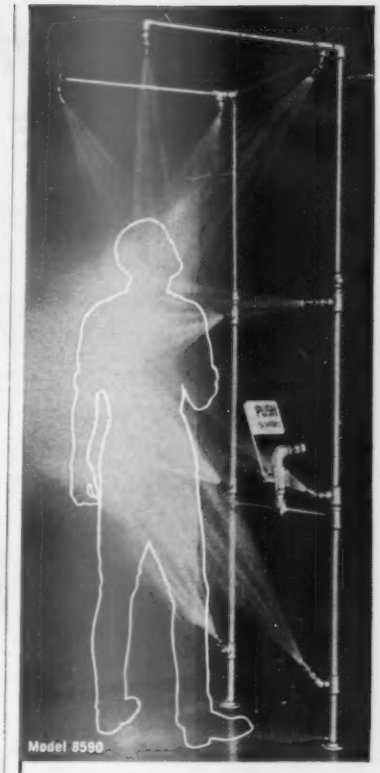
Pacific Airmotive Corp. will distribute kits in the west. Price of the kit is $19,000 or $24,500 installed.

Russians Developing New Light Helicopter

Moscow—Russia is developing a light "people's helicopter" weighing about 440 lb. and having a top speed of 56 mph. The craft, which is powered by an Irbit motorcycle engine, is 9.8 ft. long.

Designated the G-1, the one man "sports" helicopter was built by Yaroslav Gashulyak with advice from aircraft designer O. K. Antonov. It has successfully passed ground tests.

Gashulyak said his goal is to develop Russia's lightest and simplest-to-operate helicopter—"one that everybody can learn to fly." He believes that refinements can reduce the weight below 440 lb. and that performance can be improved by installing an Izhevsk motorcycle engine.



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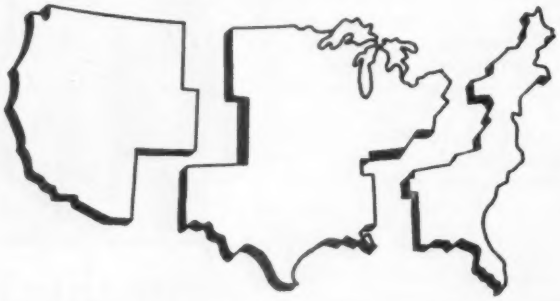

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Larger Version of Communaute Proposed

By Robert E. Farrell

Paris—Dassault and Sud Aviation have scaled up their common light transport project, the 415 Communaute, and now are seeking government financial support before launching production of the twin turboprop feeder/executive aircraft.

French Civil Aviation Ministry, whose budget will have to be tapped, recently announced that the Super Broussard would be the only French light transport project to receive government support in the foreseeable future. Industry observers, therefore, are doubtful that the money-short Ministry, which already has pumped over $2 million into the Max Holste-Nord Aviation feeder project, the Super-Broussard, will soften its position and finance a second light transport.

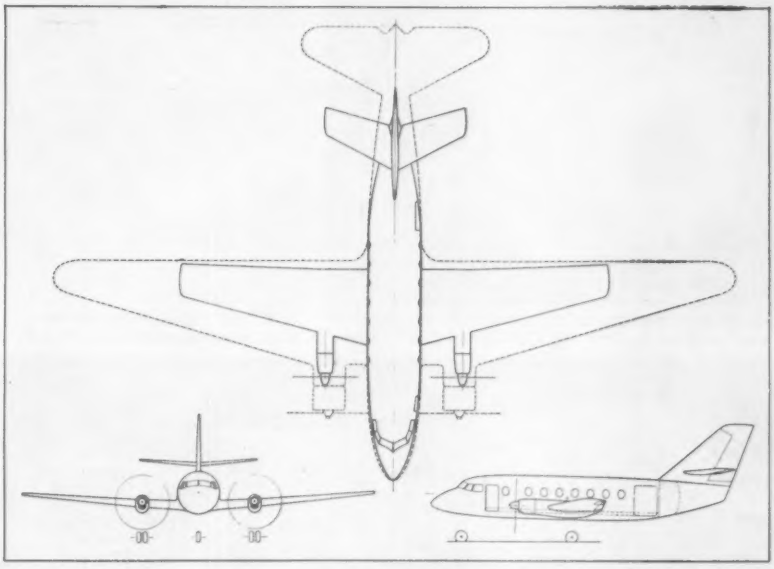
Reportedly, Dassault and Sud initially are asking for close to $12 million to finance two prototypes, tooling and testing. Without this government backing, it is unlikely the Dassault-Sud group will carry out its joint project. To avoid the program being dropped, Don Payton, president of Turbo Flight, Inc., Chicago firm which would sell the Communaute in the U.S., recently came to Paris to urge government backing. Turbo Flight reportedly has promised to purchase one of the $400,000 aircraft as soon as production gets under way. This aircraft would be used for demonstration purposes in the U.S., where Payton believes an untapped market exists for an aircraft in the category of the Communaute.

The Turbo Flight president is scheduled to return to France later this month with U.S. executives and aircraft pilots. The pilots will flight-test the single existing prototype of the 415 Communaute.

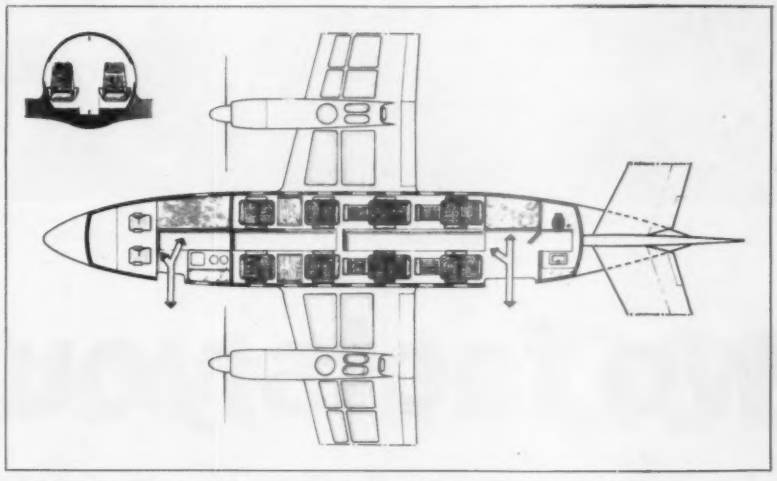
This single prototype, however, is smaller than the new Communaute version. Latter, originally designated Communaute A1, now bears the name, "Diplomate." Equipped price of the new version is about $400,000.

If French Civil Aviation Ministry backing is not forthcoming, Turbo Flight says it will take financial responsibility for marketing the smaller model, trusting that enough orders will be generated to justify full production.

Diplomate is a scaled-up extrapolation of the Communaute, 5/4th the size of the latter. Preliminary figures show that gross weight of the new version is 16,940 lb. compared with 15,430 lb. for the smaller Communaute. Diplomate, like the Communaute, will be powered by two Turbomeca Bastan turboprops of 1,000 ehp. each.



PLAN VIEW of Dassault Communaute A1 is superimposed on drawing of Douglas DC-3.



EXECUTIVE version of Diplomate has eight passenger seats, two work tables.

Aircraft will be offered essentially in the following three versions.

• **Executive:** Eight passengers can be seated in comfortable armchair-type seats with two working tables arranged forward. A 56-cu.-ft. compartment is located at the rear of the cabin and a 355-cu.-ft. compartment is available forward.

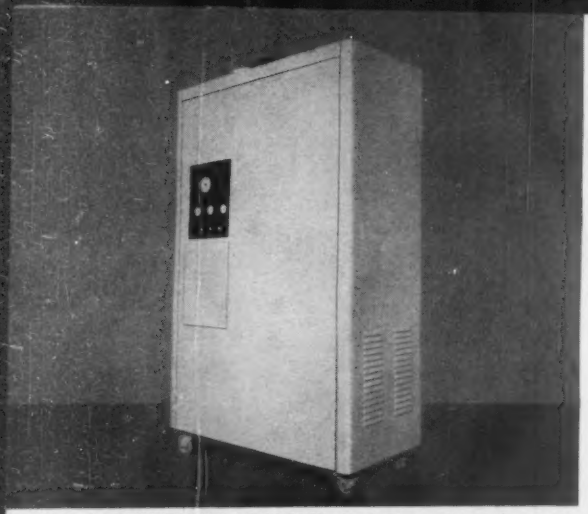
• **Transport:** In normal cabin configuration 21 passengers are seated in seven rows of double seats on one side, single on the other. It is possible to install an additional row of three seats forward, boosting total passenger capacity to 24. In the smaller Communaute version, total passenger capacity was 12.

Even with the 24-seat configuration, a 2,000-cu.-ft. compartment is available in the cabin rear. Aisle width is 1 ft. 4 in., seat spacing is 32 in. Height from recessed aisle to cabin ceiling is roughly six feet. There are eight Caravelle-type windows on each side of the cabin.

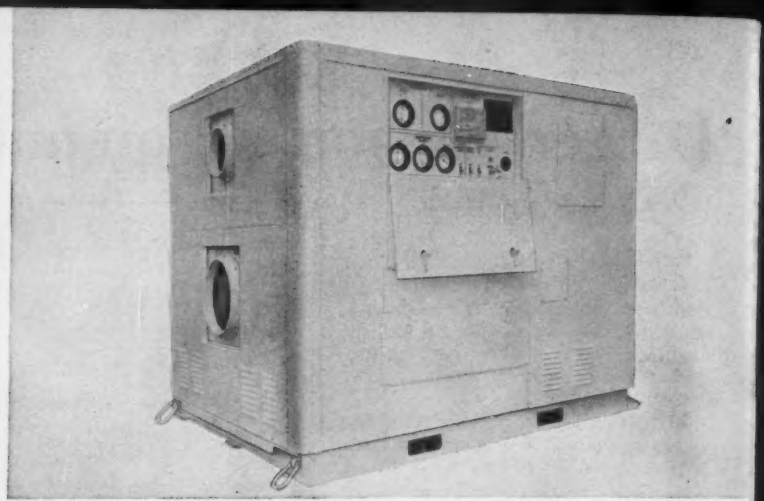
• **Cargo or mixed:** Cabin space of 36,000 cu. ft. presents several all-cargo or cargo-passenger arrangements.

Typical executive mission of the Diplomate could be carried out in the following manner:

With eight passengers plus two-man crew, Diplomate takes off at 16,800 lb. and covers 1,603 mi. at block speed of 283 mph. in 5 hr. 41 min. Major portion of flight—five hours—is carried out

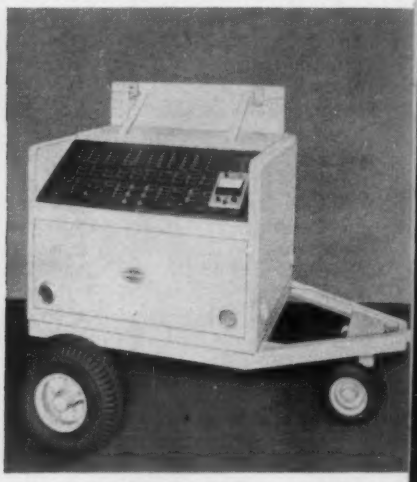


FOR THE MINUTEMAN PROGRAM—An instrument cooling pack. Delivers 25 lbs/min of air at 37°F, and 2.5 psig. for R & D testing.



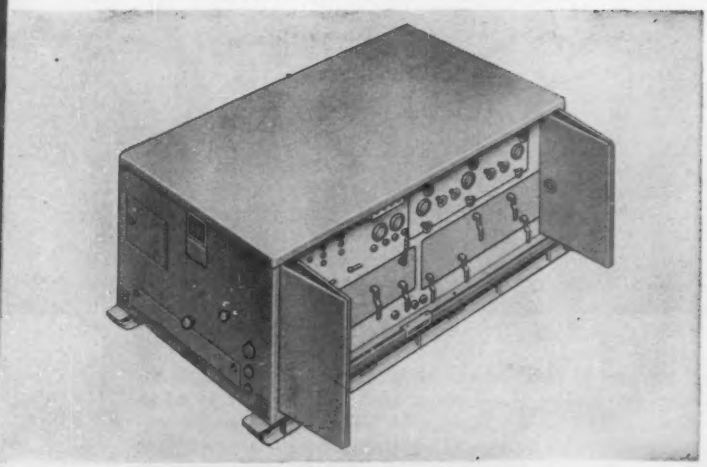
FOR THE TITAN I PROGRAM—An air-conditioner which simultaneously heats and cools guidance control gear in nose cone and lox sections of the missile, while in the silo.

FOR THE NAVY T-56 & T-58 ENGINES—A complete jet fuel control test stand. Supplies fuel flows up to 6,500 lbs/hr at 1,500 psig. Has controllable air-flow temperature range from −65 to +300°F, accurate to ±1°F.

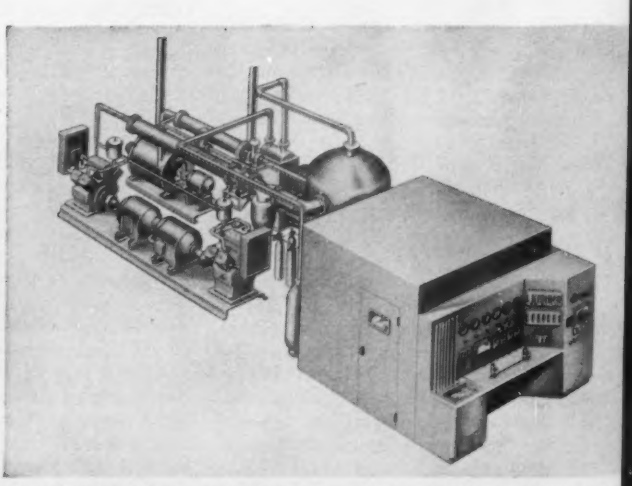


FOR THE C-130-B AIRCRAFT—A simulator which can make 100 electrical circuit checks in minutes

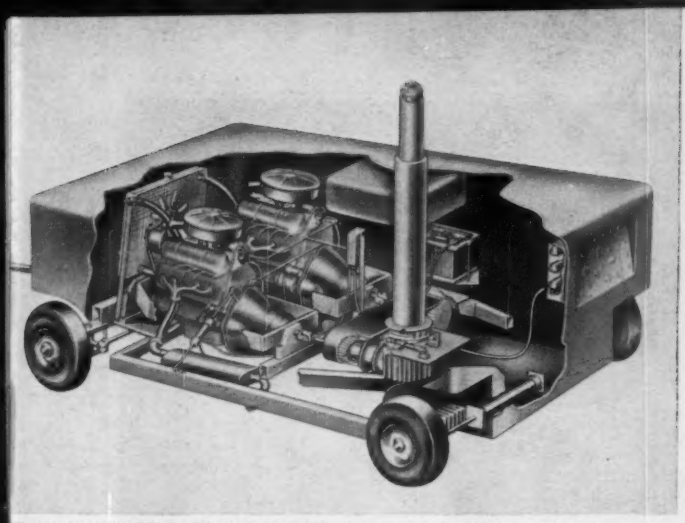
Two facts you should



FOR THE TITAN II PROGRAM—A pumping and metering unit for transfer of propellant fuel and oxidizer.

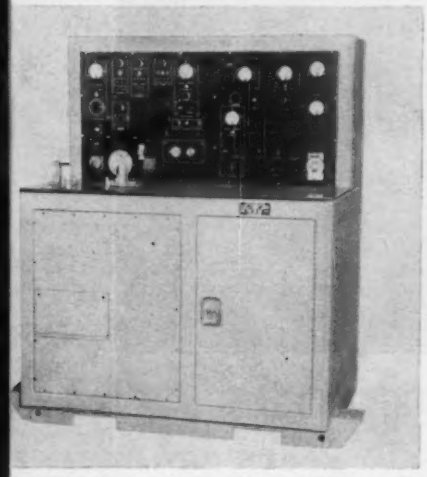


FOR THE F-104—A pneumatic test stand. Simulates flight conditions to functionally check the plane's air-conditioning system during overhaul.

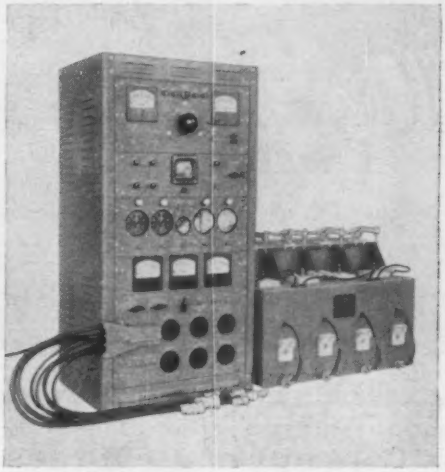


OR AN ADVANCED TURBOJET ENGINE—A new mobile starter system. Engages rectly with engine's gearbox. Offers a wide range of starting torques and speeds.

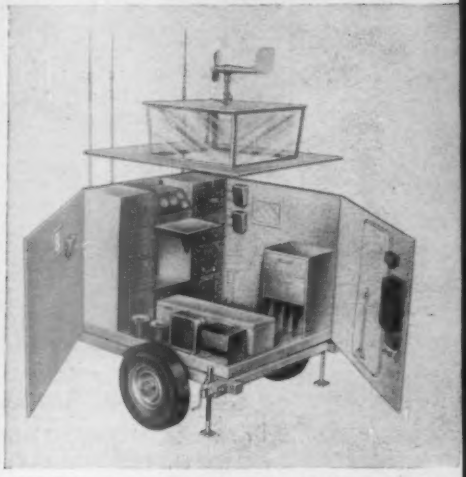
FOR AN ADVANCED FALCON MISSILE—An automatic liquid conditioner. Cools or heats electronic components, during ground checkout.



R THE B-58—A test stand for functional check of the plane's temperature-control components.



FOR THE AIR FORCE AND NAVY—A propeller synchronizer test stand for 2- and 4-engine aircraft.



FOR TAC—A portable air-traffic control "tower". Houses operator, radio and weather equipment.

know about this GSE

1. Hamilton Standard ground support equipment is the result of long, thorough experience in these basic technologies:

- **Hydraulics**
- **Pneumatics**
- **Packaging**
- **Electronics**
- **Materials Development**
- **Fuel Handling**
- **Structures**
- **Systems Engineering**

2. All Hamilton Standard GSE is implemented through one of the most advanced management procedure programs in the industry today.

If you are looking for one source, capable of supplying any type of aircraft and missile ground support equipment—from the smallest precision components to comprehensive weapon support systems . . .

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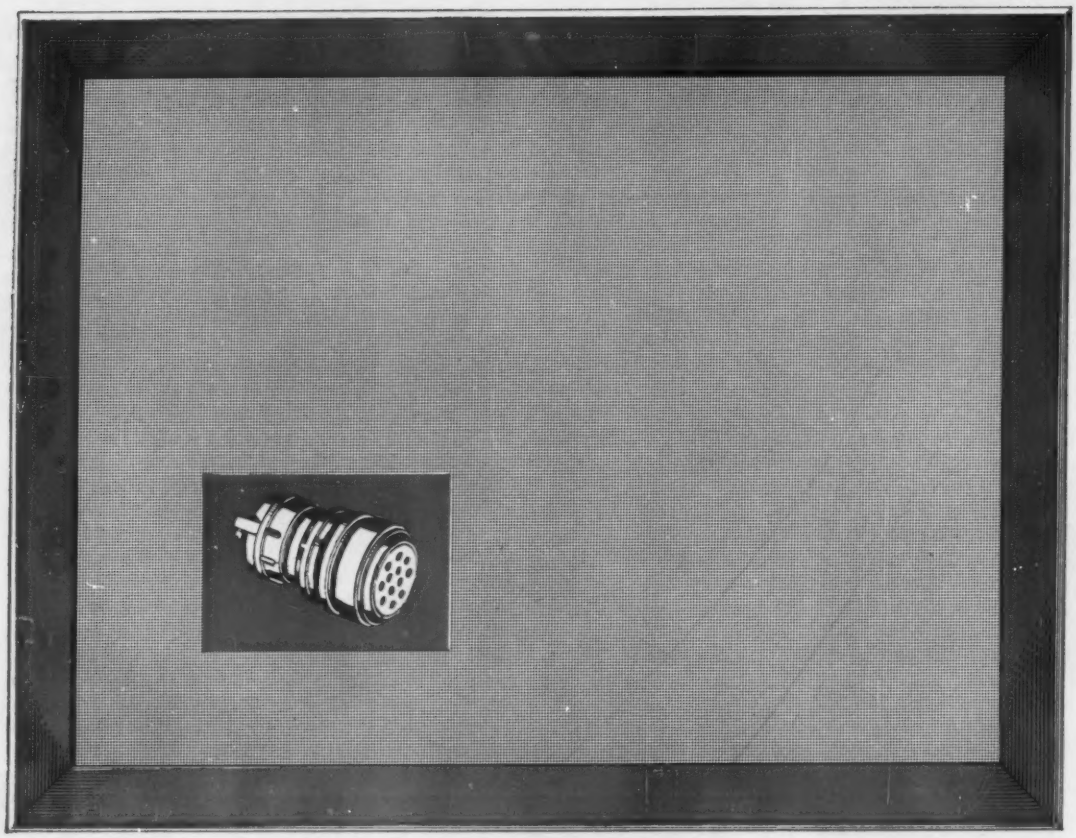
Phone: Manager, Ground Support Equipment, Hamilton Standard, Windsor Locks, Connecticut; or write for illustrated brochure.

UNITED AIRCRAFT CORPORATION

HAMILTON STANDARD DIVISION

GROUND SUPPORT EQUIPMENT



The Avnet System

created a new Concept of Readiness--5 years ago!

The dots above represent Avnet's stock of different types in 1 particular line of components (in this case, connectors). There are over 70,000 dots. Avnet's assembly facilities enable them to supply over 70,000 different types of connectors in any quantities, to meet emergency and prototype requirements. This flexibility is what The Avnet System means by "Readiness" to fill an order. Any order.

Is this a *new* state of Readiness at Avnet? Did Avnet recently stock all their Centers? Did Avnet *rush* to set up Assembly Facilities for Bendix Connector Prototype Requirements?

No!

This state of Readiness at Avnet is 5 years old. 5 years ago Avnet foresaw today's electronic requirements and began stocking in *depth*. Then assembly facilities were set up to maintain a stock in *breadth*. Depth × Breadth × Flexibility × 8 Service-Stocking Centers × On-the-spot quality control × Thorough knowledge of assembly operations for prototype needs × 5 years experience actually doing it = Readiness. It's an old story at Avnet.

And each new day brings more and more companies who want to benefit by Avnet's unique, historic Readiness. Is *your* company among them?

AVNET

THE AVNET SYSTEM
Men / Methods / Materials / Management
AVNET ELECTRONICS CORP.

Avnet Service Centers and Stocking Facilities: Los Angeles, Cal. · Sunnyvale, Cal. · Seattle, Wash. · Salt Lake City, Utah · Chicago, Ill. · Dayton, Ohio · Westbury, L. I. · Burlington, Mass.

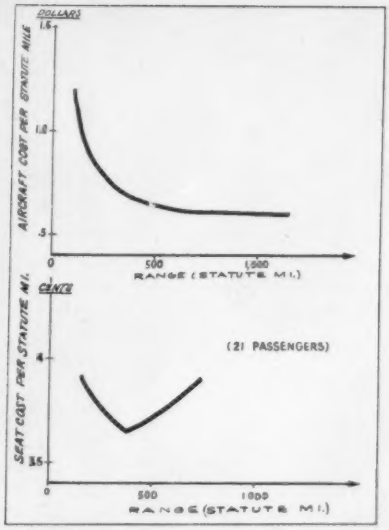
BENDIX SCINTILLA CONNECTORS	MECHANICAL PRODUCTS	SPERRY SEMICONDUCTORS	BABCOCK RELAYS	CONTROL SWITCH DIVISION	RHEEM SEMICONDUCTORS	BREMAR CONNECTORS
ROBERTSON SPLICE & CONNECTOR CASES	SPRAGUE CAPACITORS	KING SUBMIN.HI-TEMP CERAMIC CAPACITORS	VIC PRECISION TRIMMERS	U.S. SEMCOR SEMICONDUCTORS	SANGAMO CAPACITORS	MICRODOT CONNECTORS
CLARE RELAYS	AVNET AUTO. CONNECTOR AND CABLE TESTER	AVO MULTI-RANGE METERS	WIDNEY DOBLEC CONSTRUCTIONAL SYSTEM	BENALEX TUBES	SULLIVAN PRECISION MEASURING APPARATUS	SERVO DESIGN AND TESTING EQUIPMENT

Mail me information on the components circled at left.

NAME:_____

TITLE:_____

(Clip this bottom section to your letterhead, mail to The Avnet System, Publications Section, 70 State Street, Westbury, Long Island, N. Y. Your request will be expedited within 90 minutes of receipt.)



DIPLOMATE operating curves—seat cost/mi., and aircraft cost/mi.

at 20,000 ft. at 300 mph. cruise.

Typical transport mission would be run off as follows:

With 21 passengers plus two-man crew, Diplomate takes off at 16,800 lb. gross and covers 404 mi. at block speed of 234 mph. in 1 hr. 46 min. Major portion of flight—1 hr. 05 min.—is flown at 20,000 ft. at 283 mph. cruise. Example includes 155 mi. diversion.

Wing shape of the Diplomate is trapezoidal with a 12-deg. sweepback at 25% of the chord. Construction is entirely of metal.

Fuselage cross-section is circular and is 7.3 ft. in diameter. Cabin access is through rear-located door on left-hand side. Door opens upward within the cabin, is 4 ft. wide and headroom is 4.4 ft. On forward left-hand side another door opens upward externally providing a 2.15 x 3.7 ft. access. Pressurized fuselage has classic structural pattern. It is made up of frames and stringers having a tight riveting pattern.

Tail unit follows Dassault Mystere fighter design. Complete unit consists of single fin, rudder and stabilizer. Fin has symmetrical profile and 45-deg. sweepback.

Landing gear is tricycle type, main gear being equipped with dual wheels. All five wheels are identical. Main wheels retract into engine nacelles, nose wheel into forward fuselage.

Production planning, assuming a favorable government decision, calls for the first Diplomate prototype to fly in February, 1962, and the second the following May. Production aircraft would start rolling out late in 1962, with deliveries being made in January, 1963. Sud Aviation would take on about 80% of the work. Current thinking is that a monthly production rate of eight would be sought.

Dassault-Sud Diplomate

SPECIFICATIONS
(Preliminary)

Wing span	59.8 ft.
Wing area	380 sq. ft.
Fuselage length	54.4 ft.
Fuselage height	20.2 ft.
Cabin	
Width	6.8 ft.
Length	32.8 ft.
Headroom	5.11 ft.
Baggage compartment (21 passengers)	150 cu. ft.
Gross weight	16,940 lb.
Empty weight	9,300 lb.
Wing loading	37 psf.
Power loading	16.8 lb./hp.
Powerplant:	
Two Bastans of 1,000 ehp. each.	
Propeller:	
Two Ratier three-bladed props.	

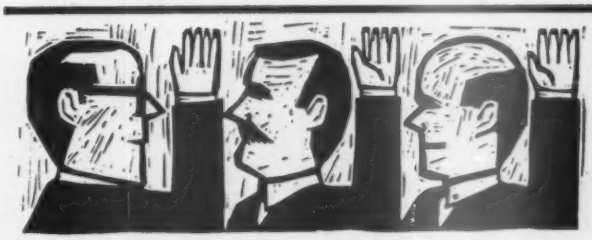
PRIVATE LINES

New intermediate altitude aeronautical charts designed to facilitate flight planning and flight operations for pilots operating in the new intermediate airway system, which became effective Apr. 6, 1961, were released by the U. S. Department of Commerce. The new charts depict information pertinent only to en route instrument navigation at altitudes from 14,500 to 24,000 ft. They include provisions for showing a low altitude "sheet-line layout" for pilots transitioning to altitudes below 14,500 ft. Charts and price information may be obtained from the Coast and Geodetic Survey, Washington 25, D. C.

Hiller Aircraft Corp. has received orders for 10 12E helicopters. Five will go to Okanagan Helicopters, Ltd., Vancouver, B. C., for use in exploration, and five to the Province of Buenos Aires, Argentina, for agricultural spray work and general missions.

February shipments of U. S. business and utility aircraft totaled 531 units having a gross factory billing value of $10,910,000, marking a reduction over January's deliveries of 654 units valued at $12,253,000. February 1961 shipments showed a marked decline from the same month last year when the 808 aircraft, having a total factory billing value of $15,464,000 were delivered. Shipments for the first two months of 1961 total 1,185 units having a billing value of $23,163,000 compared with 1,512 units in same period of 1960 having total billing value of $28,443,000.

PROBLEMATICAL RECREATIONS 63



Three men are blindfolded in a mirrorless room. Each is told that he may or may not be given a mark on his forehead, and is instructed that when the blindfolds are removed each is to raise his hand if he sees one or more marked foreheads, and to lower his hand when he rationally concludes whether his own forehead is or is not marked. Unknown to the participants, all foreheads are actually marked. The blindfolds are removed, and all hands are instantly raised. One of the men shortly lowers his hand. By what logical process does he know he is marked?

—American Mathematical Monthly

Recreationers, gather 'round. If you are enjoying the series, you might like to know that compilations of past puzzles are available in nicely illustrated booklets. You may have a copy for the asking. Ask: Problematical Recreations Department, Litton Industries, Beverly Hills, California.

ANSWER TO LAST WEEK'S PROBLEM: 764,488.

LITTON INDUSTRIES
Beverly Hills, California

Skybolt launching pad.

Any piece of sky can be the launching pad for Skybolt air launched ballistic missile. This radically new deterrent weapon is designed to have global mobility. It will be carried, and launched in flight, by the USAF B-52, or RAF Vulcan. When it becomes operational, four Skybolts may be launched from the same B-52 to strike multiple targets up to 1000 miles away. The very existence of such a flexible retaliatory force will be a formidable deterrent.

The stellar-monitored inertial guidance system for the USAF-Douglas Skybolt is being developed and built by Nortronics.

NORTRONICS
A DIVISION OF
NORTHROP

NATO F-104 to Use Compact Photo Unit

By Barry Tully

New York—Photo reconnaissance system for North Atlantic Treaty Organization tactical aircraft, designed for installation in the external fuel tanks of the Republic F-84F, will be modified for a fuselage installation on NATO Lockheed F-104 fighters.

Severe space limitations of the fuel tank led to the KS-65A photo system employing 70 mm. format cameras with a fast (1/4,000 sec.) shutter speed.

Development of the compact photographic system stemmed from the need for an aerial reconnaissance package for the F-84F. To provide this photo reconnaissance capability without extensive modifications to the aircraft, the fuel tank system was developed. J. A. Maurer, Inc., Long Island City, N. Y. developed a camera system with the Air Force, which incorporates four 70 mm. roll film cameras.

Occupying the front of one external fuel tank, the camera system reduces fuel tank capacity by 25%. The installation hampers aircraft performance only in that range is reduced slightly and, of course, the fuel tanks must be retained. Additionally, the system is designed for operation by pilots without extensive photo school training and has simplified cockpit controls.

Flight tests of the KS-65A camera system, installed in the right external fuel tank of an Air Force F-84F, were conducted last December at Brookley AFB, Mobile, Ala. Included in the flight test were some maximum speed runs flown at an absolute altitude of 100 ft. and at a speed of 585 kt. Higher runs were made up to an altitude of 30,000 ft.

The F-84F external tank camera installation utilizes four of the 70 mm. film cameras in a left oblique, right oblique and two split vertical configuration. Interchangeable lenses may be fitted with focal lengths of 1.5-in., 3-in., and 6-in. Camera weight varies slightly with the lens fitted, however, it is about 8 lb.

A focal plane shutter is employed which may be manually set prior to flight for 1/500, 1/1,000, 1/2,000 or 1/4,000 sec. shutter speed. The automatic exposure control system consists of a 605-L Clarex cell light sensing element and a computer unit with a sensor amplifier, feed-back potentiometer amplifier and the associated comparison and motor drive circuits. Iris opening range is from *f*/2.8 to *f*/16. The auto-

BROOKLEY AFB, ALA. is photographed (top) from an F-84F at 6,000 ft. flying at 450 kt. Split vertical photo was taken by a KS-65A camera system at shutter setting of 1/4,000, 5 frames per sec., 38 mm. lens. Building (bottom) was photographed by the 70 mm. format system with identical shutter setting from an F-84F at 585 kt. at 100 ft. absolute altitude.

Sonobuoy picks up ocean's noises—
including the sound of
marine life, waves and surface
ships—which may mask
the signal of a distant sub

In ASW aircraft, new signal processing equipment will extract sub's signal out of the noise

Sifting sounds from the sea

Lockheed Electronics signal processing equipment to aid airborne sub-hunters

Detecting sound from a distant submarine out of the noise of the sea is as tough as hearing a bumblebee above the roar of a jet engine. The sub can lurk within range of a listening sonobuoy, yet still not be discovered by the ASW aircraft. The general noise level of the restless sea – the motion of waves, the rumble of ships or the squeal of porpoises, for instance – may mask the faint target signal.

To lift the target signal out of the noise, Lockheed Electronics is developing airborne detection and locating equipment utilizing advanced signal processing techniques. These techniques hinge on modern information theory and noise theory–disciplines employed in optimizing the design of filters, detectors, time integrators and computers to gain improved signal-to-noise ratios.

Lockheed Aircraft, LEC's parent company, has a notable record of achievement in ASW systems. These capabilities are now augmented by the talents of Lockheed Electronics, applied to underseas warfare components and systems.

MINDING THE FUTURE

LOCKHEED ELECTRONICS COMPANY

Plainfield, New Jersey

PRECISION SIZE 5 MOTORS NOW AVAILABLE FROM STOCK

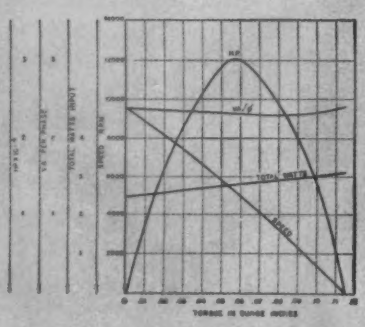
Available for immediate delivery, these miniaturized Bendix® motors (type number CK 1066-40-A1) are designed for applications where space and weight requirements are at a minimum. So small that four can be packaged in a square inch, these motors are ideally suited for missile instrumentation and similar miniaturized applications. The motor has a tapered shaft; however, units may be obtained with other type shafts and with center tapped control windings.

TYPICAL MOTOR CHARACTERISTICS

Voltage	
Fixed phase	26 volts
Control phase	26 volts
Frequency	400 cycles
Stall Current*	
Fixed Phase	100 ma
Control Phase	100 ma
Stall Impedance*	
Fixed Phase	260 = 184.5+j183.5 ohms
Control Phase	260 = 184.5+j183.5 ohms
Stall Power Input* (Total)	3.69 watts
Stall Torque	0.138 oz.-in.
No Load Speed	9900
Torque-to-Inertia Ratio (Stall Acceleration)	44,400 rad/sec²
Operating Temperature Range	−55°C. to +70°C.
Weight	0.88 oz.

*With rated voltage applied to each phase.

AVERAGE PERFORMANCE CURVES



For information on these motors—or similar motors in sizes 8, 10, 11, 15, 20, and 28—write:

Eclipse-Pioneer Division
Teterboro, N. J.

Bendix
THE BENDIX CORPORATION

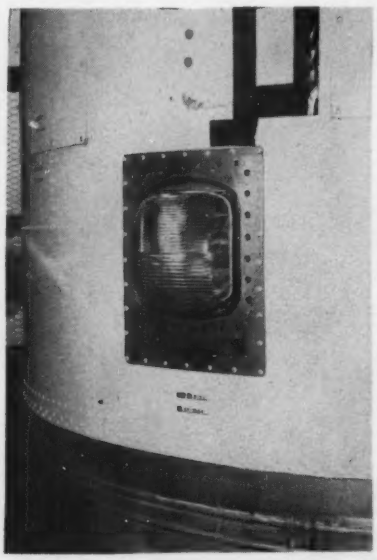
District Offices: Burbank, and San Francisco, Calif.; Seattle, Wash.; Dayton, Ohio; and Washington, D. C.
Export Sales & Service: Bendix International, 205 E. 42nd St., New York 17, N. Y.

matic exposure control requires special iris diaphragms with identical linearity characteristics and the same angular rotation stop-to-stop.

The detachable film magazine may be loaded with 15, 50 or 100 ft. of perforated roll film. Cycling rate is 5.5 cps. The 70 mm. film produces a 2¼ x 2¼ in. negative.

The KS-65A system, operating from 28 v.d.c., has a temperature range from −65 to +160F and can function through an aircraft acceleration of 8g in any direction. Contracts for the F-84F camera system, which is being supplied to NATO under the Mutual Assistance Program, total about $1.5 million.

The NATO F-104 photo reconnaissance system will utilize three 70 mm. cameras in a tri-met configuration, two split vertical and one vertical camera with different lenses. The photo system is designed to be "plugged into" an empty spent ammunition compartment on the aircraft. Thus, to convert the fighter for photo reconnaissance purposes, the guns are removed and the camera package installed. Maurer expects unit volume of the F-104 system to reach 500 and dollar volume to total $5 million. In the domestic military market, Maurer is designing uses for its 70 mm. format cameras in the photo pods proposed for the Republic F-105D fighter-bomber.



Titan Tracking Flasher

Beacon to facilitate photographic tracking of the Martin Titan missile emits 22-million candlepower flashes. The flasher, reportedly twice as brilliant as other tracking lights, has flown on the Feb. 10, Titan J shot (AW Feb. 20, p. 29) and on later Titan firings. The flasher beacon is produced by Friez Instruments Division of Bendix Corp., Baltimore, Md.

FINANCIAL

Department of Defense Releases Top Military R&D Contractors

Washington – Following continues the listing of top contractors listed according to net value of military prime contract awards for experimental, developmental, test and research activities. First portion of Department of Defense 1960 research and development awards appeared in the Apr. 10 issue of AVIATION WEEK, p. 99.

Listing is a breakdown of companies, governmental agencies and nonprofit institutions by rank.

RANK	COMPANY	LOCATION	DOLLARS (thousands)
231.	Telephonics Corp.	Huntington, N. Y.	595
232.	Firestone Tire & Rubber Co.	Akron, Ohio	587
233.	Farrand Optical Co., Inc.	New York, N. Y.	585
234.	Dunlap & Associates	Stamford, Conn.	582
235.	Hewlett-Packard Co.	Palo Alto, Cal.	580
236.	Kellett Aircraft Corp.	Willow Grove, Pa.	578
237.	Grand Central Rocket Co.	Redlands, Cal.	574
238.	Teague (Walter Dorwin) Associates	New York, N. Y.	573
239.	Epsco, Inc.	Anaheim, Cal.	568
240.	Bermite Powder Co.	Saugus, Cal.	568
241.	Textron, Inc.	Belmont, Cal.	567
242.	American Science & Engineering, Inc.	Cambridge, Mass.	564
243.	Itek Corp.	Boston, Mass.	563
244.	Barnes & Reinecke, Inc.	Chicago, Ill.	562
245.	Narmco Industries, Inc.	San Diego, Cal.	560
246.	Harris-Intertype Corp.	Cleveland, Ohio	560
247.	AlleghenyLudlum Steel Corp.	Pittsburgh, Pa.	557
248.	Feedback Controls, Inc.	Natick, Mass.	549
249.	Laboratory for Electronics	Boston, Mass.	540
250.	Nuclear Corp. of America, Inc.	Denville, N. J.	539
251.	Beechcraft Research & Development, Inc.	Boulder, Colo.	535
252.	Whirlpool Corp.	Saint Joseph, Mich.	534
253.	Sangamo Electric Co.	SpringFeld, Ill.	528
254.	Servonics, Inc.	Alexandria, Va.	517
255.	Solar Aircraft Co.	San Diego, Cal.	516
256.	Geophysics Corp. of America	Boston, Mass.	507
257.	Edgerton, Germeshausen & Grier, Inc.	Boston, Mass.	506
258.	Computer Systems, Inc.	Monmouth, N. J.	504
259.	Jered Industries, Inc.	Hazel Park, Mich.	502
260.	Manson Laboratories, Inc.	Stamford, Conn.	501
261.	Research, Inc.	Minneapolis, Minn.	500
262.	Winzen Research, Inc.	Minneapolis, Minn.	498
263.	Bliss (E. W.) Co.	Canton, Ohio	496
264.	Rucker Manufacturing Co.	Oakland, Cal.	496
265.	Fluidyne Engineering Corp.	Minneapolis, Minn.	496
266.	American M.A.R.C., Inc.	Inglewood, Cal.	495
267.	Dupont (E. I.) De Nemours & Co.	Wilmington, Del.	489
268.	Benrus Watch Co.	Waterbury, Conn.	488
269.	Dayton Electronic Products Co.	Dayton, Ohio	485
270.	Flightex Fabrics, Inc.	Cambridge, Mass.	484
271.	Packard-Bell Computer Corp.	Los Angeles, Cal.	480
272.	Isotopes, Inc.	Westwood N. J.	477
273.	Servo Corp. of America	Hicksville, N. Y.	474
274.	Alloyd Research Corp.	Cambridge, Mass.	466
275.	Treadwell (M. H.) Co., Inc.	New York, N. Y.	462
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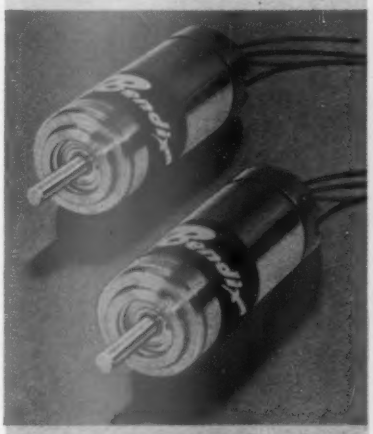

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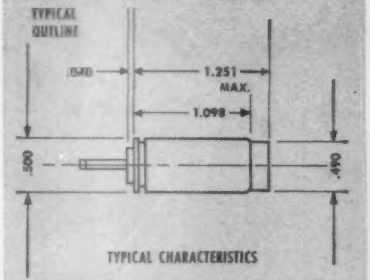

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L. W. Foster, Manager of General Electric's Tantalytic Capacitor High Reliability Program, discusses a new unique data-system approach to achieve .001% failure rate per 1000 hours

December of this year will mark the successful completion of General Electric's continuing program to achieve a Tantalytic capacitor failure rate of .001% per 1000 hours under specified test conditions. This achievement will stand out in contrast to numerous reliability claims because of the unique approach used to attain it, and the immense test sample used to prove it.

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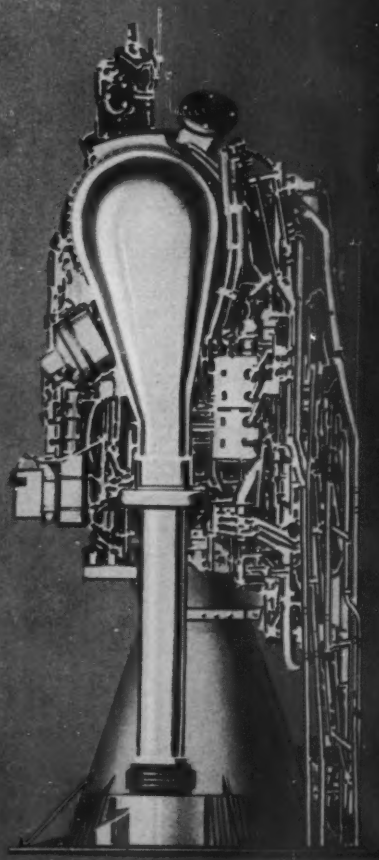

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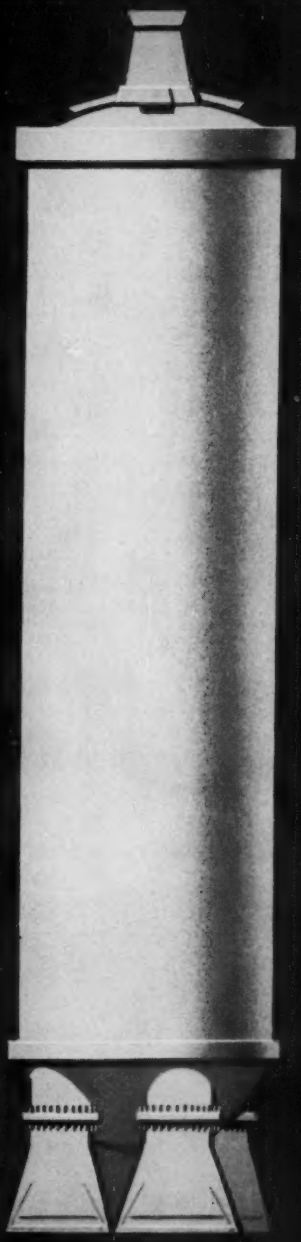
World's largest solid rocket motor, reliability proven in 8 silo launches and full scale flight.



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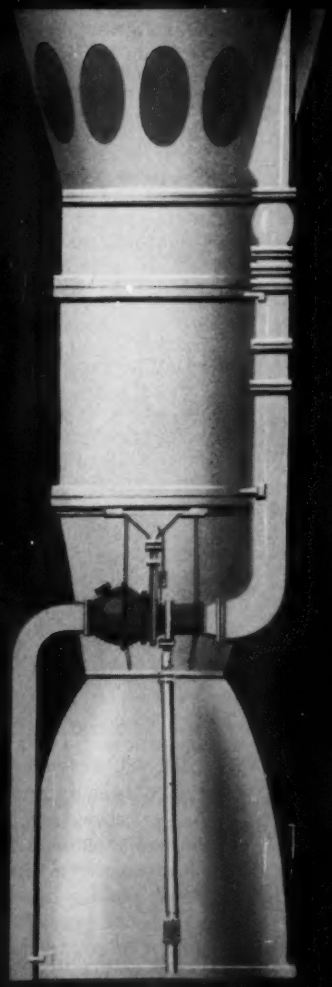

The current state of the art in rocket propulsion presents a sound foundation for development of safe, reliable nuclear engines . . . powerplants needed in ultimate space exploration through manned flight.

Thiokol's contributions to propulsion progress are many and significant.

Performance of Thiokol systems in test and flight establishes the company's own position of technological leadership. The record underscores capability to manage and direct widely diversified industrial technologies to deliver the goods at minimum cost in time and dollars.

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SILICONE NEWS from Dow Corning

Photo courtesy Fairchild Engine & Airplane Corporation

Seals Where Others Failed

Fairchild recently supplied several F-27B's to Northern Consolidated Airlines, which serves Alaska and Canada. Trouble started when temperatures dropped below —50 F. Seals caused doors to stick closed. After the doors were opened, seals were so hard the doors couldn't be closed. Silastic®, the Dow Corning silicone rubber, was used to replace the seals for the large cargo and passenger doors. Results: no sticking closed, no jamming open . . . Silastic maintains a positive seal at all altitudes despite the wide variations in temperatures encountered.

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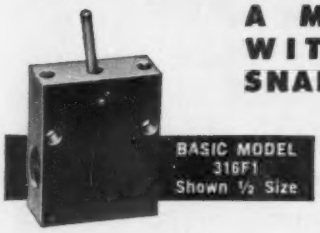

A MINIATURE VALVE WITH OVERCENTER, SNAP-ACTION OPERATOR

- Instantaneous Response with no Intermediate Position
- Full-speed Action Regardless of Operating Force
- Dimensions: Small as ⅝" x 1½" x 1¾"
- Weight: As light as 2 oz.
- For Pressure or Vacuum Service

Standard Micro Valve is a 3-way, 2-position valve and may be adapted easily for 2-way shut-off service. Also available — 4-way combination valves; single and double solenoid operated valves; single diaphragm operated valves; with male or female connections. All valves may be manifolded.

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New Offerings

Faradyne Electronics Corp., Belleville, N. J., organized in June, 1958, to engage in the manufacture and distribution of high reliability materials and basic electronic components, including dielectric and electrolytic capacitors and precision tungsten wire forms. Offering is $1,500,000 of 6% convertible subordinated debentures, for public sale at 100% of principal amount; due date of the debentures, names of underwriters, and underwriting terms to be supplied by amendment.

Nytronics, Inc., Berkeley Heights, N. J., engaged in the development, design, production and sale of custom-made and standardized electronic components for use in communications equipment, missiles, commercial computers, servos, commercial radio and television, data handling, navigational, and industrial control equipment. Offering is 100,000 shares of capital stock, for public sale on an all or none best efforts basis; offering price and underwriting terms to be supplied by amendment. Of the proceeds, $200,000 will be used for the purchase of raw materials and cost of labor to manufacture increased inventory of standardized product lines to facilitate shipment from stock; $35,000 for procurement of test equipment used in connection with standardization of product lines; $50,000 for acquisition of production machinery; the balance for working capital.

Packard Instrument Co., Inc., Lyons, Ill., engaged in the development, manufacture and sale of scientific instruments; principal products are electronic instruments for the detection and measurement of radioactivity which are used primarily in research laboratories doing tracer studies with radioactive isotopes. Offering is 100,000 shares of common stock, for public sale on an all or none basis; offering price and underwriting terms to be supplied by amendment. Offering includes an additional 10,000 shares to be offered by the company to its employes at the public offering price less the underwriting discount. Of the proceeds, $325,000 will be applied to the payment of outstanding notes payable to banks; the balance will be used (1) to expand and intensify research and development activities, (2) to provide additional working capital, and (3) for other corporate purposes, including the acquisition or construction of an office and factory building to consolidate operations now carried on in three locations.

Danish Accident Investigation Report—Part II:

Caravelle Crash Cause Remains Uncertain

This is the conclusion of a two-part report on the crash of a Scandinavian Airlines System Caravelle jet transport at Esenboga Airport, Ankara, Turkey, on Jan. 19, 1960. The first installment, which appeared in Aviation Week, *April 17, p. 141, related how the Caravelle, en route from Copenhagen to Cairo, had taken off from Istanbul and proceeded to the next intermediate stop which was Ankara. Two minutes before the aircraft crashed at Ankara, it had reported being inbound at an altitude of 6,500 ft., descending. Until that point the flight appeared to have been of a routine character.*

The descent from 17,000 ft. is of special interest here. Due to traffic circumstances, the descent was delayed but it can be ascertained that the rate of descent down to 12,000 ft. has not been very high. At the last named altitude the aircraft flew level for a short time (1-2 minutes) while waiting for further clearance to descend. After such clearance was received, a rapid descent was commenced. The time from the start of this descent until the aircraft crashed was with great probability between 3.5 and 5 min. The altitude loss of 8,500 ft. gives the rates of descent averaging respectively 2,600 and 1,700 feet per minute which means that if the time needed for start and break-off of the descent are taken into consideration, the aircraft must at times have descended 3,000 to 5,000 feet per minute. Tests have shown that even if one calculates with 3.5 min., it is possible to perform such a descent without exceeding limit speeds for certain configurations (landing gear down, etc.), but that descent with a "clean aircraft" would produce a speed close to the limit of 300 kt.

Based on tests performed, the most likely descent and approach path have been established. It is possible to state with great probability that there has been no major divergence from this approach path. The tests have shown that if the landing gear or the speed brakes were extended at some other time than assumed, it would result in almost the same flight path but with a different speed. A report on flight tests carried out at Sud Aviation shows the loss of altitude during pull-up from the steep descent and the values show that this could not have been the cause of the loss of the 1,100 ft. concerned. Considering the calculated speed of the aircraft at the time of the crash, it can also be stated with great probability that a pull-up from the descent was not the direct cause of the crash.

Altimeter Reading

Of the three altimeters in OY-KRB, two were of the old type with three pointers, and one was of the new drum-type. The latter was the main altimeter for the captain. Since the face of this instrument is new, the possibility of a misreading of 1,000 ft. cannot be precluded since the actual experience in reading it must be said to have been limited at the time of the accident.

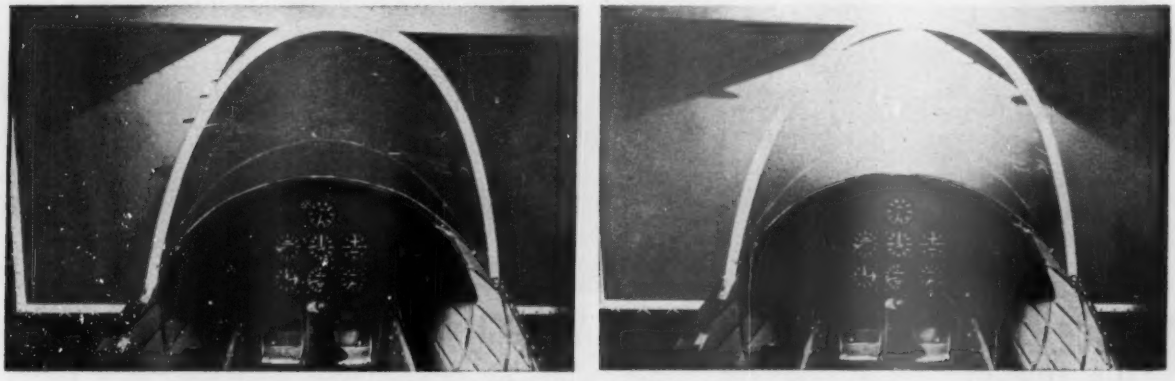
The vertical speed indicator in the Caravelle has a range of ± 6,000 ft./min. as compared to ± 2,000 ft./min. in instruments normally used in propeller aircraft. A pointer deflection for a given rate of descent is thus one third on the new instrument as compared to the old one. This might give a pilot the impression that the rate of descent is lower than actual.

At the time of the accident an ILS-system was under installation at Esenboga Airport. The localizer transmitter was in use "on test," but the glide path was not yet available. It is known that both VHF navigation receivers in the aircraft were tuned for Ankara ILS and the possibility exists that the crew may have used the ILS as a secondary approach aid, overlooking the fact that the glide path transmitter was not in use. Due to the nature of the flight director system such a mistake cannot be fully precluded if the command needles on the horizon flight director are followed without observing the warning flags on the pictorial deviation indicators.

It must be mentioned that a few days after this accident a pilot of another Caravelle aircraft under approach into Esenboga Airport, being misled by the normal indication on the horizon flight director and overlooking the warning flag on the pictorial deviation indicator, tried to use the non-existing glide path.

The fact that the approach was made from a high altitude with a high rate of descent, thereby cutting down the time for the normal cockpit procedures, may have had a marked bearing on the cockpit workload, in the light of the actual distribution of duties among the cockpit crew.

The reported as well as the actual weather at Esenboga was above minimums. The fact that the actual weather at the



Grumman Builds VTOL Simulator

Simulator for acquainting pilots with VTOL flight characteristics during takeoff and landing phases has been developed by Grumman Aircraft Engineering Co. Now being used in basic VTOL research under Navy Bureau of Weapons sponsorship, the simulator projects an image of a runway on a translucent screen in front of a cockpit mockup and changes the size and displacement of the image in accord with control movements in the cockpit. Image changes are actual responses to commands from an analog computer into which aircraft performance equations are programed. Scale for movements of elements in the projector to apparent flight condition change is 1,200-1. For example a ½ in. displacement of the light source in the projector produces an apparent altitude change of 300 ft. Six important conditions of VTOL flight can be simulated with the projector: altitudes from 6 to 300 ft., yaw 40 deg. from the axis of the runway, side displacement, 150 ft. from the centerline of the runway, velocity towards the runway of plus or minus 100 kt. and lateral and vertical velocities of plus or minus 20 fps. In operation the cockpit mockup is coupled to a pitch and roll platform so that these motions are also synchronized with control movements in the cockpit. Pitch and roll representation is viewed with reference to a horizon line on the screen.

MACE CAPABILITIES AND ACCURACY—A TOUGH INERTIAL GUIDANCE JOB ACHIEVED BY AC!

Try as they might, enemy radar eyes would have a tough time finding and tracking the Air Force Mace. Built to fly undetected by typical radar screens, the Mace twists and dodges its way to the target—unerringly! The reason: AChiever Inertial Guidance by AC . . . the most accurate and reliable means of delivering Mace to its target despite a constantly shifting flight path, low altitude winds or changing terrain. The Mace guidance package is the result of precise design and development, endless testing and careful production . . . another example of AC's way of doing business.

If you are interested in working on advanced systems like the Mace, and if you have a BS, MS or PhD in EE, ME, Physics or Math, please contact Mr. G. F. Raasch, Director of Scientific and Professional Employment, 7929 South Howell, Milwaukee 1, Wisconsin.

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Inertial Guidance for Mace, Titan and Thor. Bombing Navigation Systems for the B-52 and B-47.

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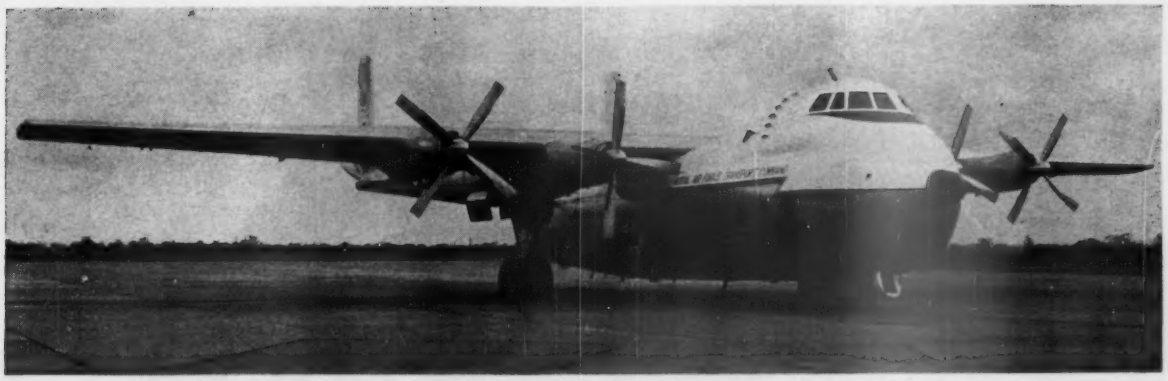

RAF's First Armstrong Whitworth C Mk.1 Argosy

Armstrong Whitworth's first C Mk.1 Argosy transport for Royal Air Force differs from the AW 650 in that it has a nose radome, a supply aimer's window below the radome, and a circular crew entry hatch, shown open, which is below the aimer's window. Note vortex generators aft of cockpit windows. The military Argosy has "crocodile jaw" cargo doors at the fuselage rear which have been opened and closed in flight. AW 650 has clamshell doors.

crash site was worse than expected cannot be considered a basic reason for descending below the minimum flight altitude, but must have taken the crew by surprise, since the actual weather at Esenboga received just before commencing the approach was much better. When the aircraft actually came in too low, the combination of bad visibility and the absence of significant land marks and lights from settlements could seriously have affected the possibility for a corrective maneuver.

The approach was primarily an NDB approach and from the position of the crash site relative to the normal approach-line and the heading of the aircraft at the first impact, it can be stated that the primary navigational aids both on ground and in the aircraft appear to have been functioning satisfactorily.

It must, however, be stated that an NDB procedure, executed directly from a steep descent from high level with a fast jet aircraft must be considered a difficult type of approach in that the time available for cockpit procedures is being cut down. The fact that the holding pattern was 70 deg. of the final approach heading constitutes an added complication. At the time of the accident, it was not generally recognized that special training in direct approach after steep descent from high level ought to form part of the training program for jet crews, so the crew had not received such training.

An NDB approach is based on a heading indication from one or more navigational aids, but the altitude and rate of descent of the aircraft are controlled exclusively through the barometric altimeter and the vertical speed indicator (rate of climb indicator).

After passing Ankara Range (ANK) the aircraft, due to the changing wind conditions, was cleared for "circling" instead of the expected "straight-in." This means that the crew had to replan the approach, check the circling minima on the chart and then finish the checklist.

The technical investigation has revealed that the various de-icing systems were in switched ON position at the time of the first impact and it is quite possible that an ice, warning was experienced shortly after passage of ANK.

This requires a resetting of the power levers, higher power being needed, and this may have caused a fuel heater warning.

It is believed that the aircraft passed ANK at an altitude of 6,500 ft., this having been reported to the tower, and a probable altitude error must therefore have occurred at a later stage.

Under the prevailing circumstances of high workload, a reading error of 1,000 ft. may have been made by the crew, but not noticed. Such error is known to have been committed during flight training in the simulator as well as in the air.

The two last radio contacts with the aircraft, made one minute before and at the passing of ANK, were routine messages, and no difficulties whatsoever were reported. It must therefore be assumed that the crew intended to continue the approach according to the instructions given by A.T.C. and that they were convinced that this could be done. It can therefore be assumed that only minor technical defects could have occurred prior to passing ANK.

The investigation revealed that the wing flaps stopped during extension in a position of 3.5 deg. It is most probable that this happened in connection with the first impact. If so, flaps were selected 8-12 sec. prior to this impact.

It is known that the speed brakes were out, landing gear down, engines under power. The impact marks show that the aircraft was in a normal attitude. This would indicate that a few seconds prior to the first impact, no serious technical defect had been ascertained by the crew, nor could such defect have developed so much as to have rendered the aircraft out of control.

On the other hand, the flaps might have come to a stop shortly prior to the impact, the cause being a hydraulic failure in the green hydraulic system. Assuming this having been the case, the crew would have received a hydraulic pressure warning, which would have been an added complication. However, no evidence of such failure has been ascertained.

In connection with the investigation, tests have revealed that certain loose equipment in the cockpit under special circumstances may block the control columns in normal or slightly nose down position. Therefore, the possibility cannot be precluded that such blocking did in fact take place.

The possibility of a temporary malfunctioning of one of the servodynes cannot altogether be precluded, but must be considered remote.

Experience, gained with other Caravelle aircraft, has shown that a sticking altimeter or smoke in the cockpit, due to failure of the red hydraulic pump motor, cannot be precluded, and might in such case have constituted an added complication for the crew. Due to the extent of damage to the equipment it has not been possible to find any evidence to support the theory of such failures.

Conclusions

The Scandinavian investigation group has arrived at the following provisional conclusions:

- **The aircraft was maintained**, loaded, dispatched and operated in accordance with valid regulations.
- **The crew** were duly licensed and trained.
- **Flight crew fatigue** or illness was not a contributing factor.
- **The ground navigational aids** available to the flight were functioning properly.
- **The communication** between the aircraft and the ground stations was normal and no technical defects or other troubles were reported.
- **The aerodrome forecast** and the actual weather reported prior to approach were more optimistic than the weather conditions encountered at the crash site.
- **The workload in the cockpit** was high during final approach, the reasons herefore being the approach technique, the distribution of the duties between the cockpit crew and the fact that the landing clearance after passage of the range station was changed from "straight in" to "circling."
- **There** was no **disintegration** in the air.
- **At the time of impact**, the aircraft was correctly lined up for the approach, and attitude and speed were normal. The undercarriage was down and locked and the speed brakes were out.
- **The wing flaps** were under extension and, at the time of the impact, **in a position of** 3.5 deg.
- **At the time of impact the aircraft** was 1,100 ft. below minimum flight altitude for

Said Gaspard de Coriolis: *"A particle which is subject to no forces in a rotating coordinate system experiences a radial acceleration and a tangential acceleration."*

It was around 1840 that Coriolis discovered what has since become known as the Coriolis Effect. He noticed objects above the earth tend to rotate relative to the earth's rotation . . . to the right in the northern hemisphere, to the left in the southern.

The Coriolis Effect is in force in outer space, too. If a space vehicle is rotated in order to establish artificial gravity, the necessarily short radius of the rotation causes a Coriolis force. This creates orientation problems for a human occupant. To eliminate this difficulty, a scientist at Lockheed Missiles and Space Division conceived the idea of connecting the vehicle to an auxiliary fuel tank by a half-mile-long cable. Thus, if the whole system is then rotated at a reduced speed around its center of mass gravity, the longer radius greatly minimizes the Coriolis force. Right now—on the drawing boards at Lockheed—is an enormously advanced space vehicle system which utilizes this concept, in addition to many others.

Fortunately, natural laws are about the only restrictions which circumscribe scientists and engineers at Lockheed Missiles and Space Division. The climate in Sunnyvale and Palo Alto, on the San Francisco Peninsula, is close to perfection. The creative atmosphere—the opportunity to work on such important projects as the DISCOVERER and MIDAS satellites, the POLARIS FBM, or even more advanced concepts such as the space system cited above—is the dream of the creative engineer.

Why not investigate future possibilities at Lockheed? Write Research and Development Staff, Dept. M-11D, 962 West El Camino Real, Sunnyvale, Calif. U.S. citizenship or existing Department of Defense industrial security clearance required.

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the section in question, and 200 ft. below the landing minima for the airport.

• **No technical defect** was found, which could have been the primary cause of the loss of altitude.

• **Examination of the primary** flight control system revealed that the servodynes were serviceable, as found, but severe contamination (steel chips, etc.) was found inside the servodynes.

On the basis of the material available the group has arrived at the following:

The cause of the accident was the fact that the aircraft during approach to Esenboga Airport descended below the minimum flight altitude, thereby hitting the ground. The reason hereof cannot be definitely established due to lack of conclusive evidence.

However, in the course of the investigation a number of adverse conditions were ascertained, some of which combined could very possibly have led to an unintended descent below the minimum safe altitude.

Recommendations

Based upon this investigation it is recommended that:

• **Below a certain altitude** maximum rate of descent should be established. (Max. 2,000 ft./min. below "min. flight altitude + 2,000 feet").

• **The crew of the jet** aircraft should receive special training in "high altitude approaches."

• **Standardized high altitude** approaches should be established at all airports with jet operation, and relevant approach charts issued.

• **ILS approach systems** should be introduced as fast as possible at all aerodromes with jet operations.

• **As regards novel instruments,** crews should receive special training in reading technique.

• **Instrument landing charts** should be supplemented with information regarding equipment "on test."

• **The best possible working** conditions should be established for the cockpit crew by keeping all but primary flying duties away from captain and co-pilot and by introducing modifications in the cockpit in order to facilitate crew work.

• **The routine cross-checking** of primary flight instruments should be stressed.

• **The drum-type altimeter** should be modified in order to reduce possibilities of misreading.

• **Action should be taken** to eliminate the possibility of misleading indications from the flight director system.

• **All servodynes** in Caravelle aircraft should be stripped and cleaned.

• **Modifications,** eliminating the possibility of jamming the control columns, should be introduced.

• **Modifications,** eliminating the possibility of smoke in the cockpit due to failure of the motor for the red hydraulic pump, should be introduced.

• **All drum-type** altimeters should be cleaned.

• **The crew should receive** information on the runway in use as early as possible during approach.

• **General (master) switch** should be modified to prevent inadvertent electrical power [illegible]s.

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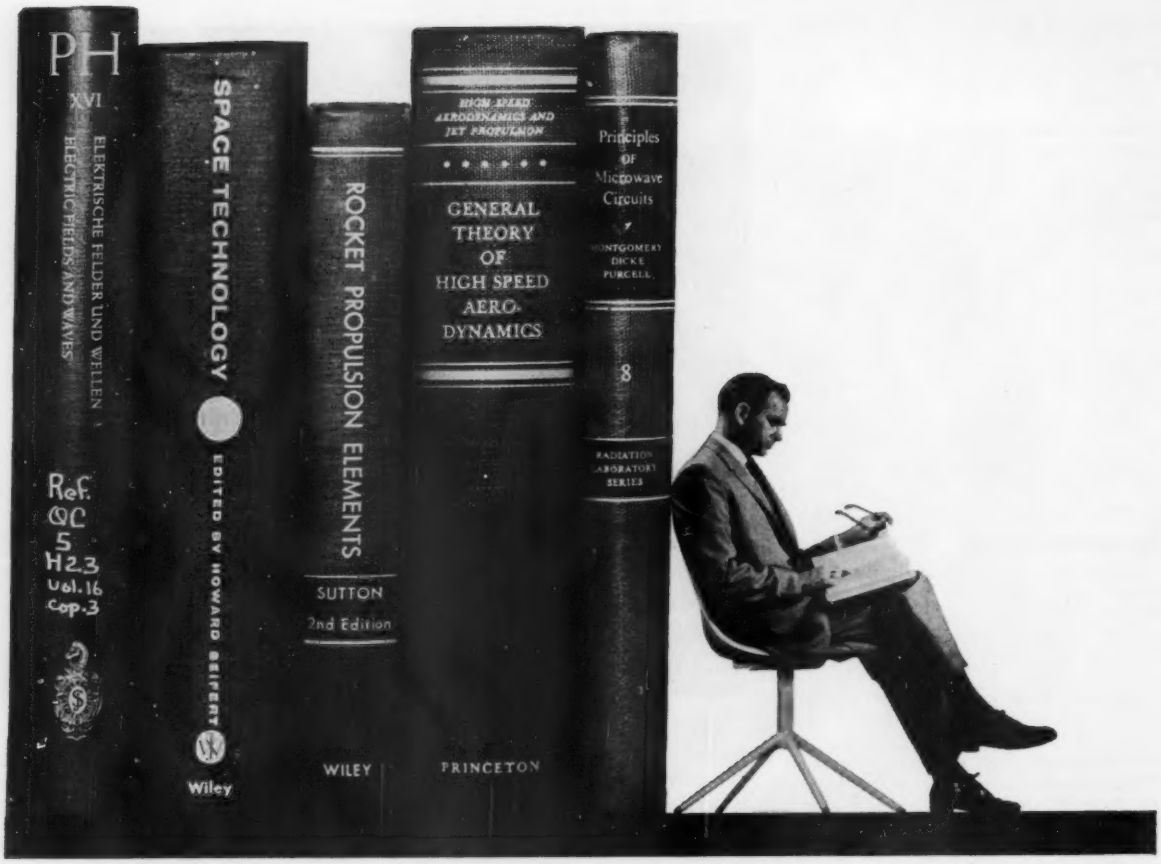

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AEROSPACE CORPORATION

WHO'S WHERE

(Continued from page 23)

Honors and Elections

United Aircraft Corp., East Hartford, Conn., has awarded its George Jackson Mead Medal for engineering achievement to **George Rosen**, head of aerodynamics and hydrodynamics at the Hamilton Standard Division, for his invention of the variable camber propeller, a new concept in propeller design which places the blades in a tandem arrangement.

Maj. Gen. Otis O. Benson, Jr., has become the second honorary member of the Order of Daedalians; Gen. Benson was honored as "The Father of Aerospace Medicine."

Dr. Charles F. Gell, chief of Life Sciences for the Astronautics Division of Chance Vought Corp., has been appointed chairman of the Life Science Committee of the nation's Aerospace Medical Assn.

Niels Bohr, Danish physicist, has been elected the first Honorary Member of the International Academy of Astronautics.

Changes

John M. Heldack, manager-direct energy conversion project, General Electric Co.'s Aircraft Accessory Turbine Department, Lynn, Mass. **Eugene H. Kissell** succeeds Mr. Heldack as manager of marketing; **Daniel W. Puffer** succeeds Mr. Kissell as manager of advance product engineering; **Allan J. Rosenberg** succeeds Mr. Puffer as manager-laboratory and test operation.

Dr. Charles F. Lombard, an authority on protective equipment for vital stress areas of the human body, has joined Northrop Corp.'s Advanced Research Center, Norair Division, Hawthorne, Calif.

J. M. Gardiner, assistant to the president, Thiokol Chemical Corp., Bristol, Pa. **R. E. Davis** succeeds Mr. Gardiner as manager of Thiokol's Washington, D. C., office; **D. R. Thielen** succeeds Mr. Davis as manager of the Dayton, Ohio, office.

Edward J. Brunenkant, Jr., director, Office of Technical Information, Atomic Energy Commission, Washington, D. C.

Kenneth O. Roebuck, Dyna-Soar program manager, the Martin Co.'s Denver (Colo.) Division.

Herbert H. Hauser, technical assistant to the chief of Advanced Design, Ryan Electronics, San Diego, Calif.

Donald W. Moore, director of engineering, ESCO Facility of Electronic Specialty Co., Los Angeles, Calif.

Brantz Mayor, regional director, Boeing International Operations office, Paris, France.

Minuteman System Management Division of Autonetics, a division of North American Aviation, Inc., Downey, Calif., has appointed the following program managers: **M. D. Margolis** for production; **T. H. McNary**, for research and development.

Dr. Nicholas Fuschillo, head of the Solid State Physics Section, Melpar, Inc., Falls Church, Va.

A. L. Buck, Jr., manager of the Washington, D. C., office of Amelco, Inc.

Edwin J. Bausch, director of marketing, Raymond Atchley, Inc., Los Angeles, Calif.

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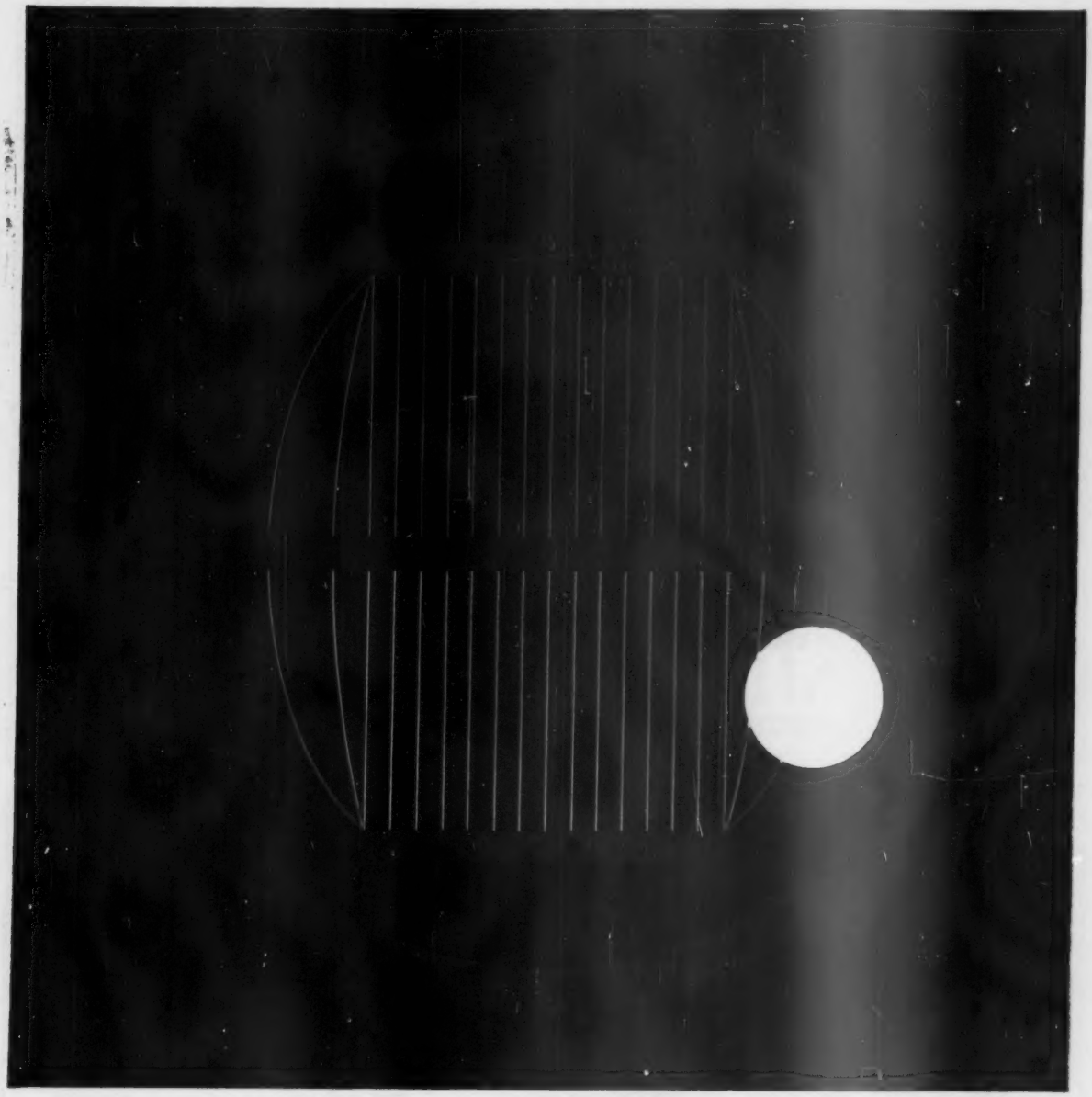

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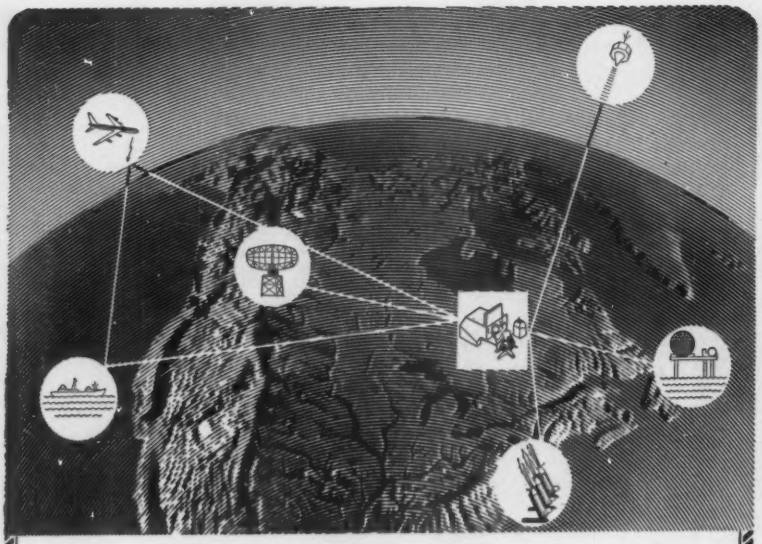

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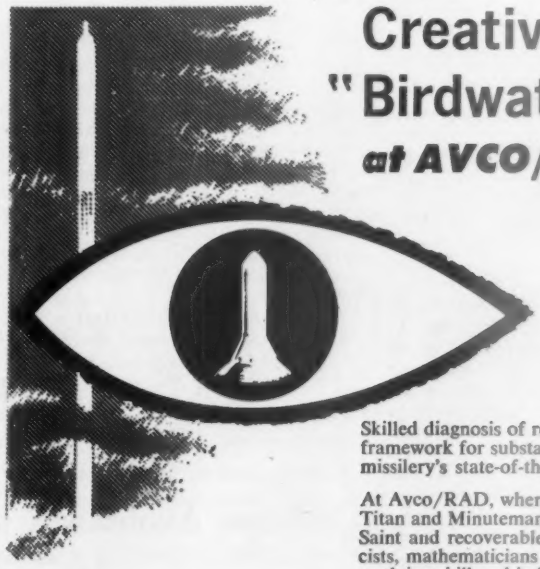

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LETTERS

Space Competition

Assertions made by our government officials when involved in discussions of the position of the United States vis-a-vis the USSR regarding competition in the space sciences have in the past and continue in the present to yield a very muddled picture to the citizenry. One, in fact, can state that there have been (and it is dismaying to observe what amounts to perseverance in this view) distortions of the truth through the naivete of those officials rendering opinions (or perhaps such naivete is attributable to their informants).

In the course of more than a cursory glance at the published testimony before the Senate Committee on Astronautics, one can find constant reference to the lead of the U. S. in "space technology" as a rebuttal of sorts to the Russian lead in booster capability. Moreover, the vast compilation of scientific data is offered as further substantiation of the U. S. lead in this branch of astronautics. One can neither deny the U. S. acquisition of huge collections of information nor the Russian orbiting advantage in orbiting payloads substantially greater than that capability shown by the United States.

The point of my letter is to offer evidence that all is not as it appears to be. The advantage may be more strongly with the USSR than we give them credit for, and hence both government officials and the public should be so advised. Rather the somewhat painful truth, than the erroneous view currently in vogue in altogether too many places.

Examination of certain translations of Russian articles on their satellites as far back as Sputnik III—launched May 15, 1958—clearly state the use of semiconductor devices (transistors, etc.) by the thousand in the instrumentation of that satellite. The significance of this and related statements is that they indicate much progress toward miniaturization.

Statements by members of the U. S. scientific community returning from Russia have included considerable praise on instrumentation and electronics capability in the USSR. I expect that those items not displayed would have raised many a scientific and engineering eyebrow quite a bit higher. The displays at the Brussels Fair and at the New York Coliseum showed first rate instrumentation for the Russian satellites and space probes both in concept and in workmanship. There is certainly no reason to believe that the replicas shown were any better than those actually aboard the spacecraft.

Because the USSR has not revealed to the world at large the scientific information it has collected is not sufficient evidence in itself that they have failed to obtain such data. For us in the U. S. to claim superiority on this basis is, to say the least, a gross misrepresentation. Each time the Russians launch a spacecraft we are reminded in the U. S. by many voices of our own small but more sophisticated counterparts to the Russian vehicles. Such statements are literally embarrassing, unproved, and dismaying to those of us in the astronautics community.

Not that our own space vehicle attempts are anything but sophisticated, but that the comparisons are unwarranted since proof of our so-called advantage is not at hand nor readily attainable from the USSR. Here, for instance, is a good example of a comparison based on misinformation: if, as has been interpreted, the continuance of broadcasting from a satellite is a measure of its sophistication, then the attempt among others to discredit the USSR by downrating their accomplishments by stating, as Mr. Glennan did in testimony, that Sputnik III was long silent before its orbit decayed, is untrue.

This bespeaks careless research on the part of Mr. Glennan's staff, for I find it difficult to believe that he would have deliberately misinformed the Senate Committee on Astronautics. Sputnik III was broadcasting up until one or two days prior to its demise; it was heard thus on the West Coast.

I take no pleasure in observing that the USSR has the substantial lead in astronautics that it enjoys, but the lack of realism and lack of careful appraisals in comparing our country with them in this field will do nothing except prolong the day when we attain pre-eminence in astronautics.

There is a sizable concentration of talent in all of the space sciences on the West Coast of the U. S., whereupon it would be to the credit of the present administration to make use of this talent in becoming better informed; a situation to our mutual advantage.

SAUNDERS B. KRAMER
Senior Member, American Astronautical Society
Fellow, British Interplanetary Society
Sunnyvale, Calif.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Collision Avoidance

With increasing regularity jet airliners are invading the once exclusively all military airspace above 20,000 ft. The congestion in this area is well known to you and your readers by the frequency of reported near-miss incidents between military and commercial aircraft. Much more frequently, however, "surprise" sightings are reported by pilots of military aircraft on VFR flight plans which indicate many more near-miss incidents or actual mid-air collisions are imminent should any pilot relax his lookout doctrine.

These incidents rarely occur at night as navigation lights can be seen at great distances and early evasion action taken. It is rare also that any pilot is "surprised" by an airliner which is in the contrail level as it, too, can be seen for forty to fifty miles.

Aircraft above or below the "con" level can rarely be seen at distances beyond six miles.

It is proposed that "artificial contrail generators" be developed for use by commercial airlines as a visual aid for sighting by pilots of military or other civil aircraft in high density traffic areas.

The writer has in mind a colored smoke generator such as that used by the U. S. Navy's "Blue Angels" and the U. S. Air Force "Thunderbird" and "Skyblazer" flight demonstration teams. Admittedly I am unaware of the space and weight requirements for such an installation and of the expense involved. Any accident prevented by such a device, however, would more than repay the basic cost.

It may be that this idea could also be incorporated as a safety device in the piston pounders.

"Eye appeal" of the general public would be enhanced, and tower operators would have an additional means of identifying traffic around the airport. Undoubtedly there will be arguments against this basically simple idea, but let's not knock it until/ unless it's been tried.

NAVY PILOT
U. S. Atlantic Fleet
c/o Fleet Post Office
New York, N. Y.

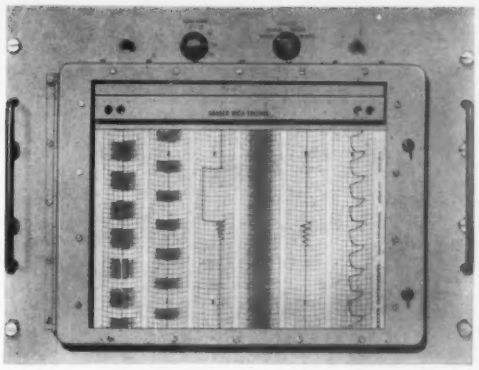
(The Federal Aviation Agency is studying possible means of generating conspicuous artificial contrails for collision avoidance purposes. In addition to weight and economic penalties, the problem involves generating a trail under varying temperature/ humidity conditions which would be more lasting than the colored water vapor trails used by flight demonstration teams.—Ed.)

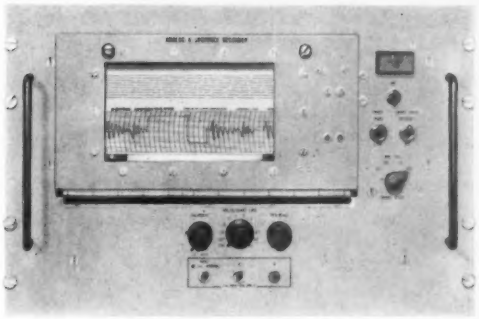
B-52H Stinger

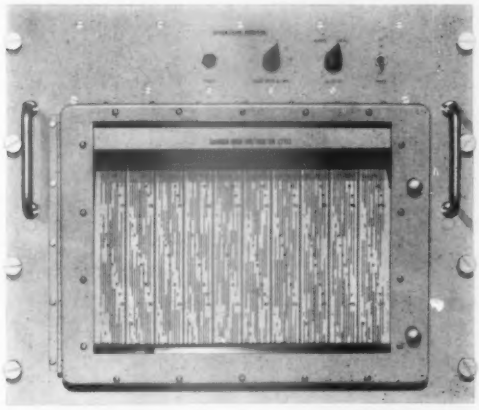
We feel obliged to bring to your attention an unfortunate print in your Mar. 13 edition. On p. 103, disassociated from any related text, you picture an aircraft tail system entitled, "GE B-52H Tail Stinger."

We at Emerson Electric of St. Louis have worked hard to establish and maintain our foremost position in the supply of bomber active defense systems. Currently in production are our MD-7 tail systems for the Convair B-58 bombers, and our ASG-21 tail systems for the Boeing B-52H bombers. Your photo depicts this latter system, developed and produced by our Electronics and Avionics Division, and currently being installed on the B-52H aircraft.

C. F. PIZAC
Director of Marketing
Emerson Electric Manufacturing Co.
St. Louis, Mo.







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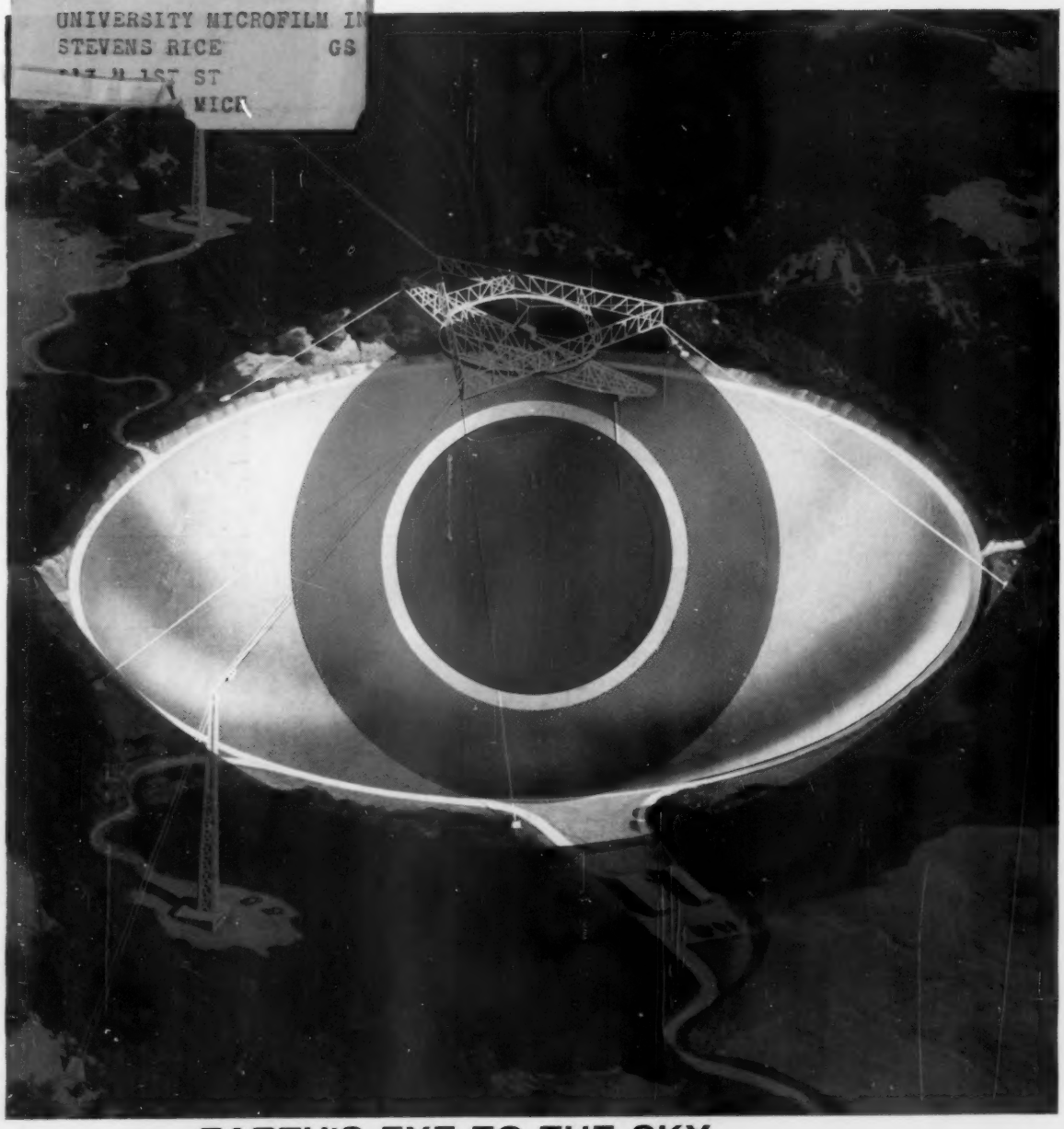

EARTH'S EYE TO THE SKY

VA-842
1.75 MW peak
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Men have searched the sky for knowledge since history began. Each generation sees farther, learns more. But the human eye is reaching its limit—and there is still much more to know.

Radar astronomy can help. In Puerto Rico, the world's largest radar will send beams from an unusually powerful transmitter into a 1,000-foot wire mesh reflector, to bounce back out into space. The returning signals will extend man's "vision" by millions of miles.

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